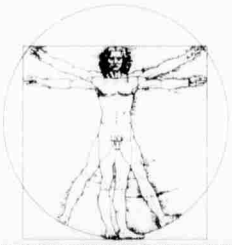
Systems Analysis
For a "New Generation" of Military Hospitals

Volume 2. Reorganization of the Base Level Military Health Care System

Final Report



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Arthur D Little, Inc.

SYSTEMS ANALYSIS
FOR A "NEW GENERATION" OF MILITARY HOSPITALS

VOLUME 2
REORGANIZATION OF THE BASE-LEVEL MILITARY HEALTH CARE SYSTEM

FINAL REPORT
TO THE ADVANCED RESEARCH PROJECTS AGENCY
OF THE DEPARTMENT OF DEFENSE

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Arthur D. Little, Inc.

SYSTEMS ANALYSIS

FOR A "NEW GENERATION" OF MILITARY HOSPITALS

LIST OF VOLUMES

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

2.1. INTRODUCTION

This volume discusses reorganization of the base-level health care system to take advantage of the innovations we propose. We have chosen the term "reorganization" because many of the changes -- particularly those concerned with light care (Section 2.3) and ambulatory care (Section 2.4) -- require changes in organization at least as much as they require changes in facilities or equipment. The same might be said of the introduction of computer systems, discussed in Section 2.5.

Delivery of health care has two important features which distinguish it from most other military activities. One is that the health care team comprises many different kinds of professionals, many of whom receive most of their professional training outside the military system. The other is that there is an exceptionally large component of "human factors" in health care. Together, these two features make the base-level health care system more dependent upon the personalities, previous training, and competence of the men and women who run it than are most other components of the military system.

For this reason, benefits from innovations in the health care system are hard to guarantee. Introducing new buildings, equipment, staff or procedures is not enough; unless there is sufficient energy and commitment behind them, the effort is not likely to succeed. For example, light care facilities have been tried in military hospitals, but they have failed in the sense that the original plan for use did not survive; they were converted to acute care facilities. This report suggests some safeguards to protect light care facilities from being caught up in the routine of acute care, but the concept cannot be made to work without commitment from those responsible for military hospitals.

For another example, the concept of using corpsmen in an expanded role in primary care arouses some legitimate concerns: how can corpsmen, who have much less training than physicians, be counted upon to provide the right treatment and recognize their own limitations? There is obviously no way to guarantee that corpsmen will not make mistakes, but there are safeguards in supervision and review which should diminish this possibility. Nevertheless, the concept cannot succeed without commitment from both the direct

participants (doctors, nurses, and corpsmen) and their superiors, all the way up to the Surgeons General.

Similarly, computers in clinical care will require a commitment to development by the military. As yet, many of the applications of computers are experimental, and many potential users -- physicians, nurses, and administrators -- remain skeptical of their value. Presently, this skepticism is not without foundation, but the promise of computers as aids to diagnosis, history-taking, and report composition is considerable. Developing computer programs for these functions will require sustained commitment until widely acceptable programs can be written and tested.

The point is simply that significant improvements in base-level health care lie less in new buildings and new equipment than in new procedures and new concepts of care. These changes will not come overnight, but they can, and we believe should, be made in the "new generation" of military hospitals.

2.2. SCOPE AND AIMS OF REORGANIZATION

The basic objective of the study has been to find ways to improve the efficiency of military hospitals while maintaining or improving the quality of care. In pursuing this aim, we have analyzed many hypotheses which held promise of improving efficiency, by themselves or in combination with each other. Analysis has been largely based on quantifiable factors, which can be related to efficiency (primarily costs and productivity), but we have tempered our analysis with several other important considerations discussed in Section 1.4 on the future of military health care. We repeat them here because they bear on the scope of the changes we recommend.

- There is already a significant shortage of trained personnel, especially physicians but also nurses and technicians, in military hospitals. There is little reason to expect this shortage to abate, and therefore alternatives which reduce the need for trained personnel are even more attractive than a comparison of present costs might suggest. This applies particularly to the concepts of using nonphysicians more extensively in primary care and dental assistants in dental care and of reducing nursing requirements through light care facilities.

- The military services are vulnerable to criticism if they fail to provide first-rate care. Such criticism is presently unwarranted, but potential criticism means that the services must stay at the forefront of quality.

- For the same reason, and also to provide a stimulating atmosphere for personnel of the military health care system, the military services should stay close to the forefront of research in health care delivery. This is

one of the important reasons for exploration and development of possibilities with nonphysicians and with computers.

On the strength of these considerations as well as more specific cost-benefit analyses, we have reached our conclusions about the various concepts introduced in Section 1.5. To outline the scope of changes we recommend in the base-level health care system, our conclusions are summarized here. (Innovations in facilities and the planning process are presented in Volume 3.)

Concepts with important savings and benefits

- Light care facilities
- Reorganization of primary (ambulatory) care to make more use of nonphysicians (corpsmen and nurses with special training)
- Use of more dental assistants, with more training, enabling them to place restorations
- Full use of convenience foods
- Modular design and multitrack scheduling

Concepts with modest savings and benefits

- More use of automated equipment including computers in the clinical laboratory
- Vacuum trash and linen collection
- Unit packaging of medications and automated dispensing
- Planning units and computer-aided layouts

Concepts which appeared attractive but are demonstrably inferior to present practices

- Multiphasic testing for physical examinations
- Wholesale use of disposable linens
- Automated materials handling
- Computer-controlled patient monitoring systems
- Elimination of obstetrical services

Concepts which appeared promising but which are probably unworkable, unrealistic or unimportant (at least for now)

- New incentives for efficiency on the part of staff of military hospitals
- Full-scale management information system

Concepts insufficiently developed to be certain of their merit but with enough promise to warrant further R&D

- Remote consultation by television
- Automated hospital information system
- Computer applications such as history-taking, report composition, computer-aided diagnosis, appointment scheduling, and duty scheduling for nurses and other personnel.

Thus, the scope of changes recommended includes concepts with important or modest savings and benefits, and, ultimately, concepts refined by further R&D. The scope excludes those concepts definitely or probably found wanting. In a few words, practice in hospitals of the "new generation" will use fewer staff (because of the light care facilities), will make more use of nonphysicians and dental assistants, and will be more automated through the use of computers, automatic analyzers, convenience foods, and vacuum trash and linen collection.

2.3. LIGHT CARE FACILITIES

2.3.1. INTRODUCTION

This portion of our report describes our recommendations on reorganization of the inpatient facilities for the hospitalization of active-duty personnel.

The military base health care system should not only have beds for acute care but also light care facilities with beds for the active-duty patients requiring convalescent type of treatment. This recommendation would satisfy the basic premise of our study for the DOD, which asked:

> "Which elements and functions of the military hospital should be modified to reduce current hospital cost trends while maintaining or improving the quality of patient care?"

The next three sections describe the concept, the advantages, the type of patient to be accommodated at this light care unit, as well as the operations and physical characteristics of the proposed facilities, with a sketch of the recommended unit. The fifth section summarizes the anticipated impact of this reorganization with respect to the three military hospitals that we have studied. The last portion of this section deals with the recommendation of evaluating the project practically, possibly under a separate R&D effort.

2.3.2. THE CONCEPT OF LIGHT CARE

2.3.2.1. General Comments

Patients in military hospitals vary widely in their dependency on doctors, nurses, and a variety of facilities. While some are acutely dependent on staff and equipment, others need almost no nursing care. This is especially so for active-duty patients. As shown in Section 5.7, a very large percentage are fully ambulatory and do not require beds in an expensively equipped and staffed acute hospital. Figure 2.3.1 illustrates this fact

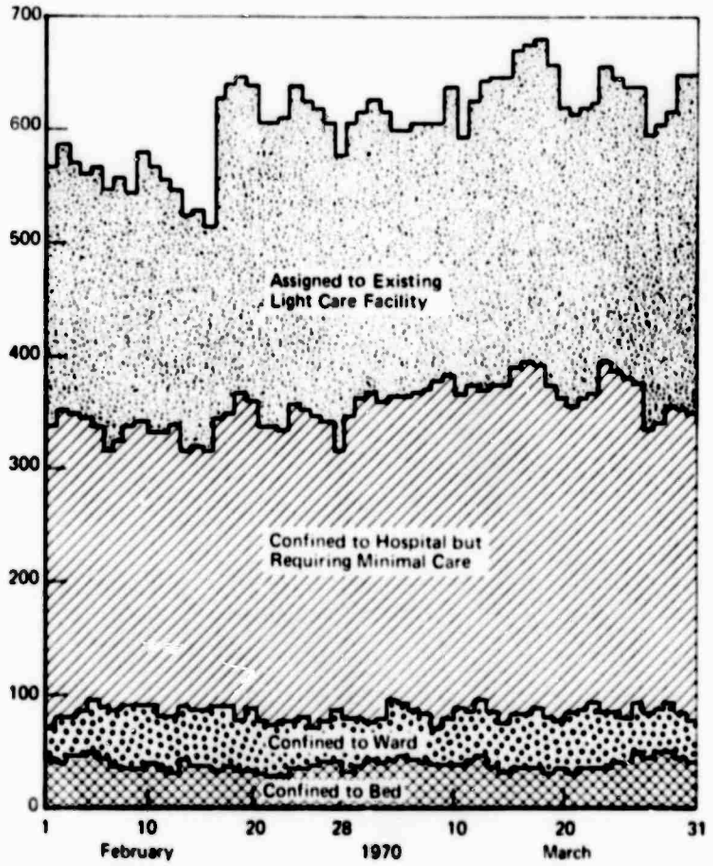
for a naval hospital, and the observation is generally true in all base-level military hospitals, though the proportions differ.

The fact that many active-duty patients are not very sick suggests that they might be more efficiently cared for in a light care unit. This, of course, is not a completely new idea. What is new, however, is the practical recognition of this type of care as an integral part of a planned sequence of patient care.

2.3.2.2. Advantages

The advantages of having a light care facility for the hospitalization of a considerable proportion of active-duty personnel who would otherwise occupy acute beds are the following:

- It reduces the growing cost of medical hospital care, particularly nursing and housekeeping care.
- It uses fewer professional personnel.
- It does not sacrifice the quality of care, in some respects improves it.
- Professional staff members can concentrate in the acute care facility.
- There is a "morale boost" for any patient when he makes the grade and is moved from an acute to a light care facility. This in turn has important implications for the complete recovery of patients, including neuropsychiatric patients.
- When light care facilities are available, the availability of beds for new admissions into the acute facility increases, due to the prompt disposition of patients by the medical staff.



COURTESY OF ADMIRAL J.L. YON

FIGURE 2.3.1 DAILY RECORD OF HOSPITALIZED ACTIVE-DUTY PATIENTS PORTSMOUTH NAVAL HOSPITAL

- It will allow perhaps 60% of neuropsychiatric patients now admitted to closed neuropsychiatric wards in acute hospitals to be housed in a more appropriate environment. This would not only benefit the patients but would also allow a reduction in the size of the acute psychiatric facility and its staff.

- Traffic flow in the acute inpatient area can be better controlled. There will be no mixing of sick and ambulatory patients and no utilization of elevators by them to and from acute areas.

- Hospital routines, such as daily linen changes, periodic temperature-taking, ward rounds by physicians, charting, and serving of meals in rooms will be provided to those who need it in the acute area but not to those in the light care unit.

- An adequate number of showers, baths, and toilets will be available at the light care facility to serve the needs of ambulatory patients. (This is not the case now in acute facilities.)

- Patients in the light care facility are removed from the activities of the acute hospital, by which they are regarded as outpatients.

- Patients can be more quickly evacuated in case of fire and beds will be more readily available in the event of mass casualty, by moving the light care unit patients elsewhere.

- Ambulatory patients will be under closer control.

- Adequate recreational facilities will be provided.

- The concept can be applied immediately to the planned prototype and even as part of a present military hospital planned to expand. This would mean easier planning, faster construction, and lower operating expenses without disrupting activities in the acute hospital.

2.3.2.3. Disadvantages

Disadvantages are as follows:

- Fewer acute beds will be available.
- Patients will generally not be seen by physicians every day.
- More control will have to be established to detect setbacks.
- Maintenance of discipline will require a special effort.
- Appointments for professional services have to be obtained and monitored.
- Care will have to be exercised regarding the medication that the patients keep.
- Neuropsychiatric patients will have to be supervised.

2.3.2.4. Location

In general a light care facility should be a separate building adjacent to the acute hospital. Locating it far from the hospital reduces control and leads to problems with supervision. Locating it within the hospital makes it likely that it will be converted to acute care and makes it difficult to realize some desirable design features, although in small hospitals (less than 200 beds) a separate facility is usually not justifiable.

A light care unit is intended for patients who are already recuperating. However, the danger of relapse or of a new ailment in the convalescent patient entitles him to the advantages of proximity to the acute hospital facilities. In the military, having this facility located close to the acute hospital area also has advantages of a nonmedical nature, such as:

- It is near the baggage room, post office, cash office, barber shop, vending machines, and other facilities at the acute hospital.

- Transportation, change of clothing, passes, etc., are not required when going to the attending medical staff or diagnostic or therapeutic facilities, even when using wheelchairs or crutches.

- There are administrative controls and access to the patient-holding detachment, chaplain, accounting office, and record room.

2.3.3. PATIENTS OF LIGHT CARE FACILITY

2.3.3.1. Problems with Dependents

We have purposely limited the use of beds at the recommended light care facility to active military patients because:

- Relatively few dependents are ambulatory in military hospitals. When they reach this stage, they usually go to their homes.

- Dependents are generally occupying beds in specialty areas - obstetrics, pediatrics, gynecology, nursery - and when light care facilities are provided, they are not much used by such patients.

- Many potential problems are eliminated such as those arising from different size beds, cross-infection, limited number of female attendants in military hospitals, mixing of patients of both sexes, discipline and routines, and the provision of toilets and other facilities.

- Keeping dependents out of this facility will prevent inundating it with long-term, chronic patients. This arrangement will insure that even after a period of prolonged convalescence the active military will not become permanent occupants.

2.3.3.2. Active Duty Military Patients

Active duty military patients in medical and surgical areas presently use 63% of the beds at March, 69% at Jacksonville, and 79% at Fort Dix. Our studies have indicated that the active military patients being admitted to these beds fall within two large categories:

- Patients being admitted for a very short time, mostly for the treatment of acute respiratory or digestive disorders; and

- Patients remaining for prolonged periods of time, mostly due to orthopedic, digestive, or respiratory conditions (e.g., amputations, fractures, herniorraphies, hepatitis, pneumonia).

We have analyzed data on 29,000 admissions to March, Fort Dix, and Jacksonville by length of stay, age, diagnosis, admission by day of the week, etc. The significant results of this analysis are given in Tables 2.3.1 and 2.3.2 (for methodology see Section 5.7). Long-term cases among the active military patients account for a very high percentage of the total number of hospital days (Table 2.3.1). We therefore recommend that the light care facility be primarily used for these cases rather than the short-term acute admissions of less than 72 hours, which account for only a small percentage of the total number of days (Table 2.3.2).

TABLE 2.3.1

PERCENTAGE OF LONG-TERM PATIENTS AND PERCENTAGE OF DAYS IN HOSPITAL
(Active-duty military patients only)

	ADMISSIONS FOR				PERCENTAGE OF DAYS			
DAYS	11 to 15	16 to 20	21 to 30	31 & up	11 to 15	16 to 20	21 to 30	31 & up
HOSPITAL								
March	3.4%	1.9%	1.8%	5.5%	6.9%	5.3%	6.9%	30.4%
Jacksonville	8.0%	5.1%	5.8%	11.0%	10.2%	9.1%	14.3%	38.1%
Fort Dix	12.6%	7.4%	12.6%	28.4%	8.9%	7.3%	17.4%	53.9%

TABLE 2.3.2

PERCENTAGE OF SHORT-TERM PATIENTS AND PERCENTAGE OF DAYS IN HOSPITAL
(Active-duty military patients only)

	ADMISSIONS FOR			PERCENTAGE OF DAYS		
HOSPITAL	1 DAY	2 DAYS	3 DAYS	1 DAY ADMISSION	2 DAY	3 DAY
March	5.2%	22.7%	19.5%	0.8%	7.0%	9.1%
Jacksonville	10.2%	16.2%	8.6%	1.0%	3.2%	2.5%
Fort Dix	2.1%	3.6%	4.7%	0.1%	0.4%	0.7%

The patient who would be transferred from the acute hospital bed to the light care facility would therefore be:

- A male patient on active duty;
- Fully ambulatory, in the sense that he can walk or move with wheelchair or crutches to have his meals at the hospital mass hall;
- Free of fever or communicable infection;
- Expected to remain for at least several days (transferring patients for a very brief period near the end of their hospital stay would not be advisable);
- Requiring little or no personal nursing care; and
- Able to have with him and take the medication he requires, based on the prescriptions obtained from his attending physician and filled at the acute hospital pharmacy.

2.3.4. DESCRIPTION OF THE LIGHT CARE FACILITY

In the following pages we describe the recommended light care facility. Certain general operational standards, staffing patterns, and services to be provided could be easily standardized. However, the details of design, size, and construction will vary depending upon local circumstances.

2.3.4.1. Characteristics and Layout

The light care facility should be near the parent "acute hospital," preferably connected to its OPD area through a covered walkway. The light care facility should have only one or two floors, depending upon size, with ramps for wheelchairs. It should have a semidomestic environment. Customary standards for air conditioning and other patient requirements in the

area will be maintained. In addition to the bed space, there will be ample space for recreation and occupational therapy. This will include:

- Auditorium - also used for movies, occupational therapy, and sports such as handball;
- Game room - for table tennis, cards;
- TV room; and
- Lending library - under Gray Ladies or Red Cross volunteers; will include writing area.

A mess hall or dining room area will allow all patients to be served. A pantry area, mainly for night use and for feeding ulcer patients, is essential.

The rather large number of showers, toilets, and other services are geared towards these fully ambulatory patients, some of whom will be using crutches or wheelchairs.

The nurses' station will provide the necessary space for the staff. Its location will allow for control and supervision of access to the facility and for maintenance of order and discipline on the premises.

The private rooms will be used by patients of officer status or by those requiring such facilities because of contagious disease or other medical reasons.

There will be no need for a nursing call system from every bed to the nursing station. We would recommend only one call button per room, located near the door and used only for emergencies.

Installing a central "Muzak" type system could be beneficial, at least in certain areas.

Conveniently located loudspeakers will be needed to call patients or to transmit instructions.

Wheelchair bays will keep wheelchairs out of the way but available when needed.

There will be no need for a mechanized material handling system. Large amounts of supplies will not be used in the light care facility.

The treatment room should be close to the nursing station.

A small laundry room for personal clothing is indicated.

As an example, a layout with details omitted for the light care facility for Jacksonville is illustrated in Figures 2.3.2, 2.3.3, and 2.3.4.

2.3.4.2. Services to be Provided

Patients will be transferred to this light care facility from the acute hospital. No direct outside admissions will take place, except under very unusual circumstances, such as a patient from another area who requires a few days' stay for diagnostic work-up at OPD level at the hospital.

Only active military patients will be accepted. All of them will be free of infection and practically all with normal temperatures and requiring no bed care.

The patients will be able to walk or move around (wheelchairs and crutches), have showers or baths, use the toilet facilities, and have their meals at the dining room area. Diets for the diabetic and the obese, as well as high-protein, low-residue, and peptic ulcer diets also will be served. Neuropsychiatric patients not requiring the closed facilities at the acute hospital will be accepted here; they would obtain their treatment as outpatients from the psychiatric unit at the acute hospital.

Oxygen and suction can be made available for emergencies at the light care facility through portable equipment.* Other standby equipment, such as a defibrillator and a tracheotomy tray, can also be kept ready.

The nursing staff will be capable of immediate detection of any postoperative complication or new ailment. In every case of this type the

*It should be borne in mind that the light care facility can be converted to an acute care facility, as mentioned in Section 2.3.5. However, conversion requires substantial change, including relocating walls, pipes, etc.; oxygen and suction would be installed at the time of conversion.

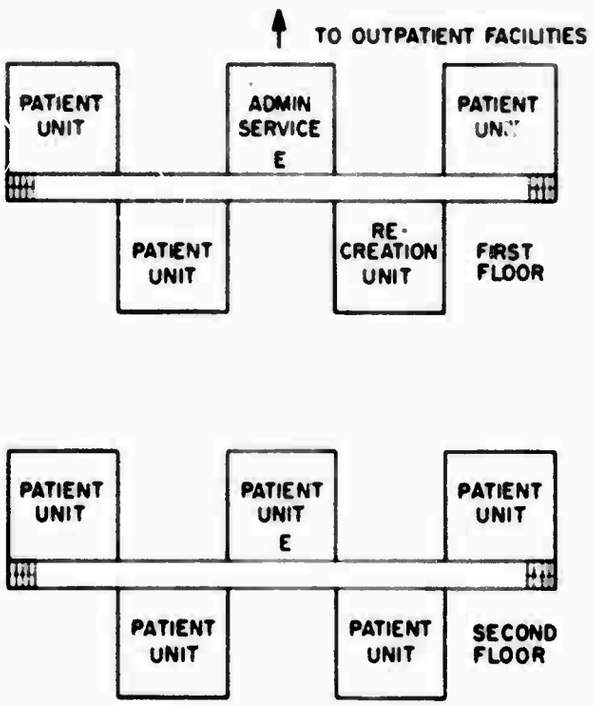


FIGURE 2.3.2 LIGHT CARE UNIT

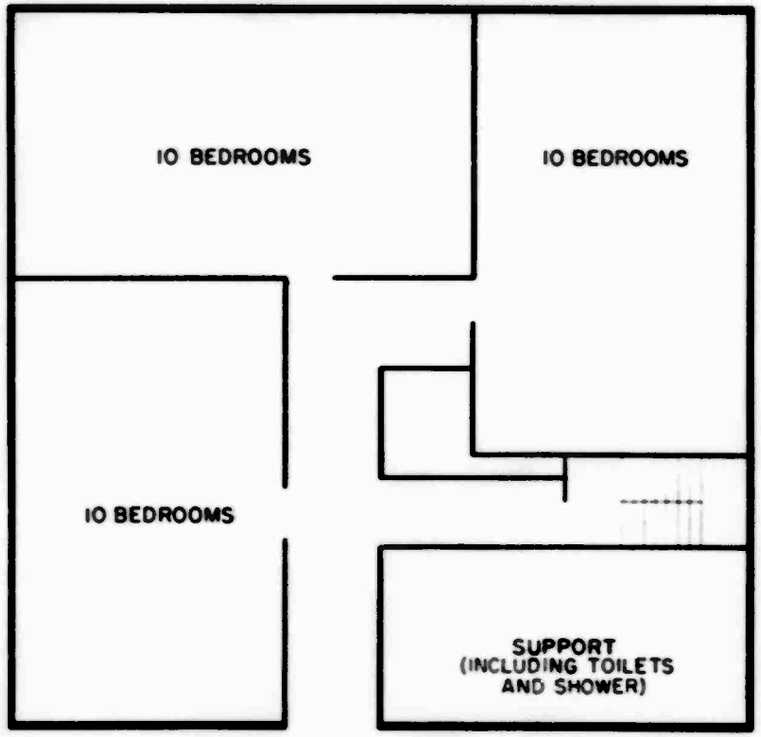


FIGURE 2.3.3 PATIENT UNIT

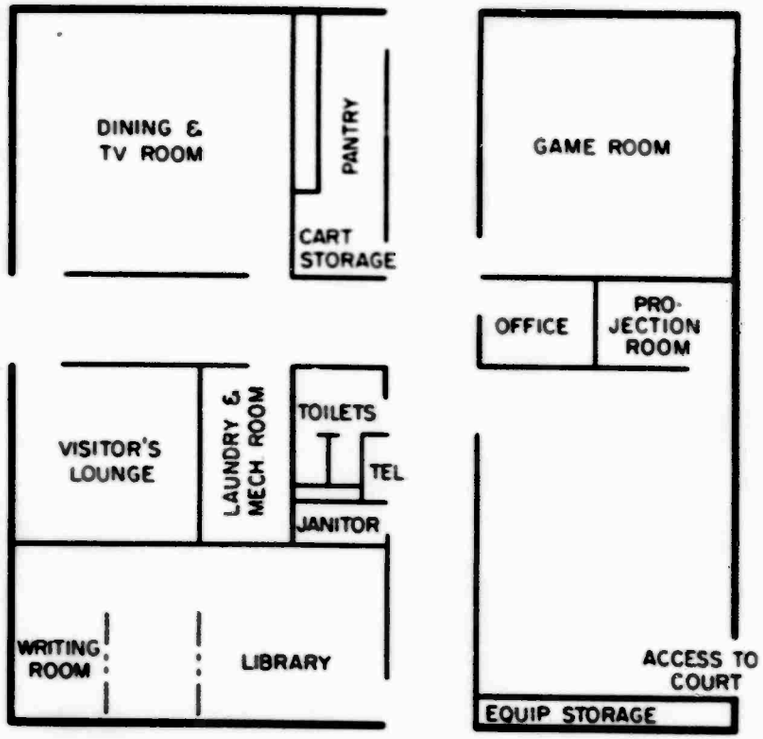


FIGURE 2.3.4 RECREATION UNIT

patient can be rapidly readmitted to the parent hospital. Volunteers and therapists plus other staff from the acute hospital will assist at the light care facility according to prearranged schedules.

2.3.4.3. Operating Procedures

Many procedures contemplated for the light care facility would be no different from those currently practiced in military hospitals for ambulatory inpatients. However, they would be systematically and consistently applied.

2.3.4.3.1. Records

Only very simple and basic record-keeping will be maintained at the light care facility. Any results of X-ray or laboratory examinations ordered by the treating physician at the acute hospital will be handled as an OPD case. Although patient charts (normally the same chart used at the acute facility) will be carried at the light care facility, no doctors' rounds will take place. However, it is essential that the ward clerk and supervising nurse see that every patient at the light care facility keeps his appointments as arranged.

2.3.4.3.2. Meals

No meals will be served to patients at their bedside. They will all go to the dining room area. Meals (including diets) will be brought over from the hospital. If and when convenience food is utilized, the patients themselves could use microwave ovens in the dining area. Milk or other beverages can be provided from the pantry to the patients at night, especially to ulcer cases requiring frequent intake.

2.3.4.3.3. Medication

The nursing staff will have available only simple stock medication that can be issued when required. Every patient, however, will have his own medication, obtained from the pharmacy with the prescription issued to him. He will take the medication himself as he would do at home. Exceptions of course would be the injectables that will be given by the nursing staff in the facility's treatment room, or any others that require nursing supervision.

2.3.4.3.4. Treatments

In addition to the injections that patients may need, there will be changes of dressings and other treatments that the nursing staff will carry out. These will be performed in the treatment room.

2.3.4.3.5. Laundry and Linen Service

The same procedures of linen collection and distribution used at the main hospital will be used here. However, the bed linen will not be changed with the frequency that is customary in acute hospitals. The patients themselves will do this work. A few washing and drying machines of the household type will be available at the light care facility for the patients to wash their personal clothing, if they wish. A number of patients may, in fact, wear their own clothes or uniform instead of hospital clothing, particularly those who are assigned other duties.

2.3.4.3.6. Recreation

The light care unit will provide the necessary facilities for recreation needed by those patients who now spend many long hours with nothing to do. A lending library area under the control of Red Cross or Gray Ladies volunteers, where patients can read, write letters, and the like will be available. The TV room and the game room will also provide recreation. At the auditorium, movies can be shown, and that same area can be used for occupational therapy. Keeping the patients busy will be an important therapeutic measure, especially for psychiatric patients.

One way of characterizing the patients in the light care facility is that they are those able to enjoy recreational facilities. This in itself will be an incentive for moving patients from the acute to the light care facility and will assist in the rapid turnover of beds.

2.3.4.3.7. Showers, Tub Rooms, and Toilets

All patients will be able to use these facilities by themselves, without or with only slight assistance. Depending on treatments (large casts, extensive dressings) some patients will not be able, of course, to make full use of these facilities. An emergency call system will be installed,

allowing patients to call a nurse or a corpsman. A bedpan washer/sanitizer will be installed.

2.3.4.3.8. Housekeeping

The patients themselves will be able to provide most of the housekeeping activities at the light care facility. This will include bedmaking, changing of linen, and other cleaning activities. Assistance will, however, be required by some patients, mainly orthopedic cases who are not completely able to use their limbs. The nurse in charge will coordinate this activity. Boards with daily assignments for each patient will be posted.

2.3.4.3.9. Maintenance and Repairs

The light care facility will be entirely dependent upon the acute hospital for these services. They, in turn, will require the assistance from the base workshops and maintenance units in some cases.

2.3.4.3.10. Storage

The baggage room at the acute hospital will, in most cases, store the personal effects of every man at the light care facility. However, because of his ambulatory status, many patients may wish to have their possessions, just as they would in a barrack.

2.3.4.3.11. Fire Drills

With ambulatory patients, the fire hazard (due mainly to smoking) is greater than in an acute hospital area. Careful supervision will have to be exercised by the nursing staff, and frequent fire drills should take place. Patients who cannot move around easily without wheelchairs should obviously not be assigned to rooms on the second floor.

2.3.4.3.12. Mass Casualties

The light care facility could be easily made available as an annex to the acute hospital, in the event of a catastrophy or mass casualties. The ambulatory patients could be transferred to other base facilities in such an emergency.

2.3.4.3.13. Laboratory Samples

Patients who require laboratory tests will leave their samples or have samples drawn at the laboratory on an outpatient basis. Exceptions (e.g., early morning sputum samples) will be handled when necessary by the nursing staff at the light care facility.

2.3.4.4. Staffing

Only a very limited nursing staff will be needed in the light care facility, not only because of the kind of patients that will be admitted but also because:

- They will be ambulatory;
- They require little or no nursing care;
- They need no assistance for showers or meals;
- They will generally self-administer medication; and
- Housekeeping will be kept to a minimum by personnel other than the patients.

The number of beds at the light care facility will determine the personnel needed. Our staffing estimates are shown in Table 2.3.3.

TABLE 2.3.3

ESTIMATED STAFF FOR LIGHT CARE FACILITY

	50 Beds			100 Beds			200 Beds			300 Beds		
	A.M.	P.M.	Night	A.M.	P.M.	Night	A.M.	P.M.	Night	A.M.	P.M.	Night
Supervising nurses	1	1	1	1	1	1	1	1	1	1	1	1
Ward clerk				1			1			1	1	
Corpsmen	1	1		2	1	1	4	2	2	5	4	4
Relief (nurses, clerks, corpsmen)	2			4				5			8	
Total	7			12			17			26		

This staffing reflects the philosophy outlined for the light care facility, taking into account the findings reported with regard to required care. Relief includes nurses, clerks and corpsmen as appropriate, and the numbers shown should in some instances be regarded as full-time equivalents rather than individuals. For example, a 50-bed unit requires a daily staff of five (a nurse and corpsman on the morning and afternoon shifts; a nurse on the night shift), a total of 40 man-hours per day, or 280 man-hours per week. If each staff member works 40 hours per week, seven are required.

As described before, the acute hospital will be responsible for maintenance and repair, supplies, food service, and volunteer programs. In general, it will also provide the same administrative backup as for patients in the acute hospital wards.

2.3.5. ANTICIPATED IMPACT

2.3.5.1. Beds

We have carried out detailed bed surveys on several occasions to determine the number of ambulatory patients to whom beds are allocated in the three military hospitals under discussion. These surveys are described in an appendix (Section 5.7). On the basis of these we conclude that the number of acute beds at military hospitals is far too large. At Walson Army Hospital, the number of acute beds of all types could be reduced from 896 to 546 (Table 2.3.4); at Jacksonville Naval Hospital, the number could be reduced from 520 to 295; (Table 2.3.5); and at March AFB Hospital, the number could be reduced from 230 to 180 (Table 2.3.6).

All of the above reductions would represent acute beds occupied by active military personnel; we have not altered the number of beds available to dependents, in spite of a rather low utilization in certain areas. We recommend that beds for dependents not be reduced, because if maternity, nursery, gynecology, pediatrics, and other services are to be provided, these beds will be needed. The ideal number at each base could not be determined, because of variations in the dependent population, the utilization of existing facilities, the availability of other facilities nearby, coverage under the CHAMPUS program, the preferences of each patient,

TABLE 2.3.4

EFFECT OF LIGHT CARE UNIT
WALSON ARMY HOSPITAL

A) MALE MEDICAL AND SURGICAL UNITS
ALSO INCLUDES AIRVAC AND PRISON BEDS

	CURRENT			PROPOSED		
	BEDS	PATIENTS	NURSING STAFF	BEDS	PATIENTS	NURSING STAFF
WAH	705	481	161	355	206	100
LIGHT CARE UNIT	–	–	–	350	255	32
				705	461	132
B) OTHER UNITS, FOR DEPENDENTS INCLUDING MATERNITY, PEDIATRICS AND NURSERY	191			191		
	896			896		

TABLE 2.3.5

EFFECT OF LIGHT CARE UNIT
JACKSONVILLE NAVAL AIR STATION HOSPITAL

A) MALE MEDICAL AND SURGICAL UNITS

	CURRENT			PROPOSED		
UNIT	BEDS	PATIENTS	NURSING STAFF	BEDS	PATIENTS	NURSING STAFF
8E OFFICERS	38	24	11	15	7	7
7E SURGICAL	50	47	11	38	23	10
7W MEDICAL	50	31	11			
6E ORTHOPEDIC	50	47	12	50	38	12
6W SURGICAL	50	42	9			
4E CONTAGION	22	16	6	16	10	5
4 PSYCHIATRIC	21	16	9	15	11	6
3 CONVALESCENT	76	69	5	0	0	0
LIGHT CARE UNIT				225	208	20
TOTAL	357	296	74	357	298	84
B) OTHER UNITS, FOR DEPENDENTS INCLUDING MATERNITY, PEDIATRICS AND NURSERY	183			183		

TABLE 2.3.6

EFFECT OF LIGHT CARE UNIT
MARCH AIR FORCE BASE HOSPITAL

A) MALE MEDICAL AND SURGICAL UNITS

	CURRENT			PROPOSED		
UNIT	BEDS	PATIENTS	NURSING STAFF	BEDS	PATIENTS	STAFF
1 ORTHOPEDIC	50	46	17	42	29	12
2 MEDICINE	43	17	16	20	11	10
2A PSYCHIATRIC	15	9	16	3	1	7
3 SURGERY	38	33	22	31	20	14
				96	61	43
LIGHT CARE UNIT				50	43	7
	146	104	73	146	104	60
B) OTHER UNITS, FOR DEPENDENTS INCLUDING MATERNITY, PEDIATRICS AND NURSERY	84			84		
TOTAL BEDS	230			230		

and even the availability of a specialist at a given moment.

We have therefore concluded that the requirements for light care beds at the three locations are as follows:

Walson	350
Jacksonville	225
March AFB	50

2.3.5.2. Nursing Staff

We have carefully analyzed, by ward, the weekly nursing staff assignments at the three hospitals. Tables 2.3.4, 2.3.5, and 2.3.6 show the total number of nurses presently assigned to acute wards and treating military patients only. The reallocation of beds, reducing the number of light care beds and creating light care beds, is based upon the inpatient surveys described in Section 5.7. These tables also show the nursing staff which would be required if we reduced the number of acute beds, and the number needed for light care facilities of the above-mentioned sizes. According to these figures, the following reductions in the nursing staff could be achieved:

49 at Walson,

14 at Jacksonville, and

23 at March AFB.

These reductions in nursing staff would not impair the quality of nursing care. Walson now provides 2 1/2 hours of nursing per active military patient per day, Jacksonville provides 2 hours, and March AFB provides 4 hours. With the recommended light care facilities and the reduction of nursing staff, a military patient in an acute bed will receive a higher ratio of nursing care: 3 hours at Walson, 2 1/2 hours at Jacksonville, and 4 1/4 hours at March*.

*The nursing staff at March AFB does much of the housekeeping work on wards.

2.3.5.3. Costs

We believe that the establishment of light care facilities as part of the "new generation" of military hospitals will significantly reduce the present costs of operation.

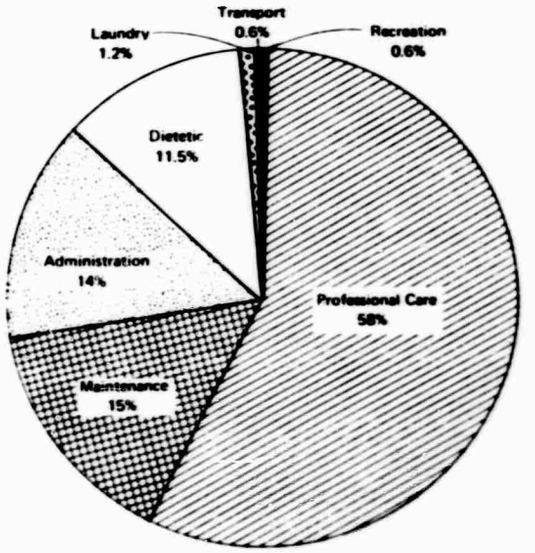
As shown in Figure 2.3.5, if such facilities were in use today at the three hospitals we studied, their total operating costs would be reduced by at least $1 million a year. (This is a conservative estimate and includes increasing the average hours of nursing care provided in acute hospitals.)

This cost reduction has been estimated only in direct savings of nursing staff salaries, linen, laundry, and housekeeping expenses. Many more subtle issues are involved that would reduce costs significantly further if we placed a price tag on the great time savings and other benefits resulting from moving the ambulatory patients.

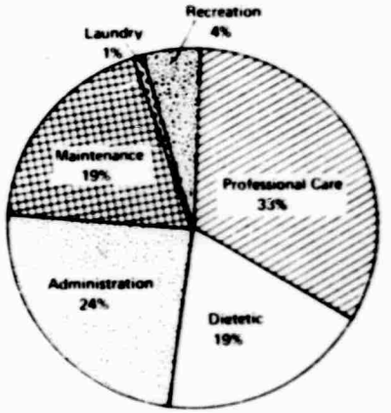
It is true, of course, that military hospitals already use patients for a good deal of the work of running the hospital such as housekeeping, linen changes, and some clerical activities. The extent to which this is done depends on local policy, but in any event in the figures to follow we have not counted savings to accrue from using patients in the work of running the hospital except as reflected in the explicit reduction of nursing staff (Tables 2.3.4-6).

Costs per patient day in a light care unit would be considerably less than a patient day in an acute care hospital. Figure 2.3.6 illustrates this difference as well as the composition of this daily expense. Furthermore in the future these costs per patient day in a light care unit will not rise as dramatically as costs per patient day in an acute hospital.

These light care units will cost considerably less to build than comparable space in an acute hospital. In the case of Jacksonville, the 225-bed light care unit would cost $1,599,000 instead of $3,040,000 for equivalent bed space in an acute facility. For emergency expansion the

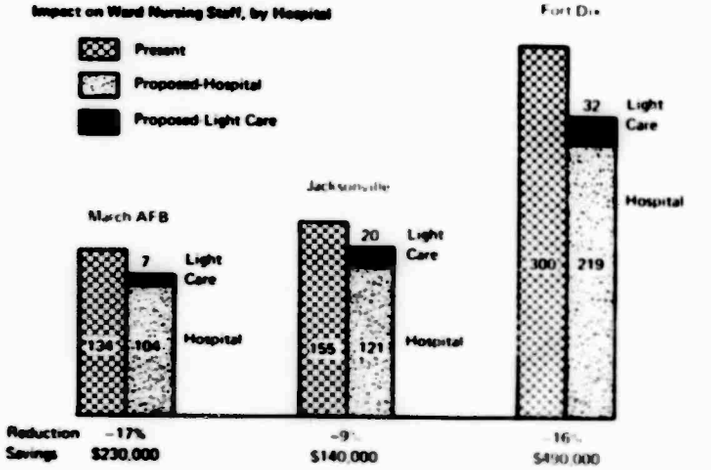


A. Acute Care Hospital (JRH)



B. Recommended Light Care Unit

FIGURE 2.3.5 IMPACT OF LIGHT CARE UNITS ON HOSPITAL OPERATING COSTS



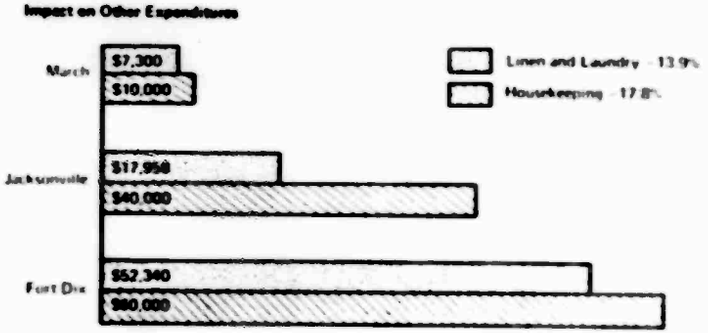


FIGURE 2.3.6 DISTRIBUTION OF COSTS PER INPATIENT DAY

light care unit can be converted into an acute care area at a cost of $660,000 for 144 beds.* The arrangement of the converted facility would be as shown in Figure 2.3.7.

2.3.6. PHASE II - EVALUATION OF THE SCHEME

In the RFP issued by the Department of Defense prior to the initiation of this study, it was mentioned that the total program had two phases. The objective of Phase II was described as:

> "Design and construction of a single military hospital with maximum feasible utilization of the advance management concepts, subsystems and components identified in Phase I."

We hope that we may be given the opportunity of developing Phase II in order to implement these recommendations and thereby fully evaluate this scheme. of action.

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*These costs were computed using cost data developed in Volume 6, Table 6.7.5. From this table the sum of the factors for a two-story structure and shell is found to be 2465. This was reduced to 2290 to account for lower cost exteriors. The table gives 1230 as the factor for interior finishes and services for nursing wards, and this was reduced to 610 because fewer partitions are used and less equipment is necessary. This produces a total factor of 2900. The factor is to be multiplied by the total square footage required and a cost factor, different for different regions and different times - in San Francisco in June 1970 it was .0115, the value used here. The required total of 225 beds can be accommodated in eight planning modules of 4800 square feet and 30 beds each, as shown in Figure 2.3.3. Two additional modules for recreation units, with the same cost factor, were added. Thus the cost works out to be

2900 x 10 x 4800 x .0115 = $1,599,000

Because a structural module for acute care has only 16 beds, as shown in Figure 2.3.7., 14 modules would be required for 225 beds. From Table 6.7.5 the cost factor for acute care nursing wards in a two-story building is found to be 3520 (2290 as before plus 1230 for partitions, etc.). Thus the cost works out to be

3520 x 14 x 4800 x .0115 = $2,720,000

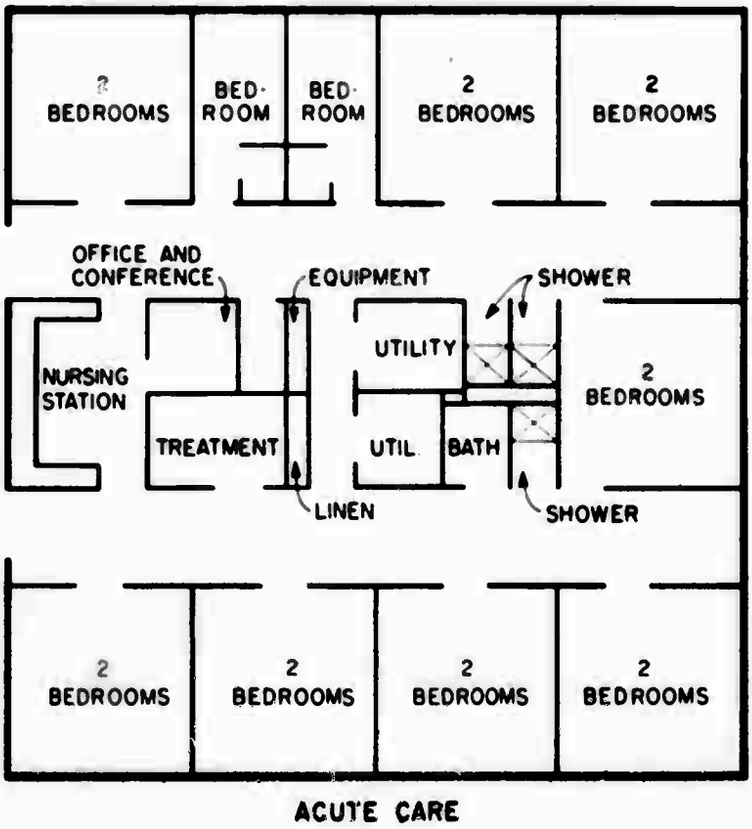

FIGURE 2.3.7 LIGHT CARE UNIT CONVERTED FOR ACUTE CARE

To this was added the cost of two recreation modules to make the figures comparable, making a total of $3,040,000.

If the light care facility had to be converted to an acute care facility, this could be done as indicated in Figure 2.3.7. The conversion cost has been estimated as $660,000. The total cost for a converted light care facility is less that the cost for an acute care facility because there are only 144 beds in the converted facility.

2.3.7. REFERENCES

Western Medicine, Janary,1966, "Medicenters of America"
Self-care units in vicinity of large medical centers; 100-bed units (one 50-bed), one RN 24 hours for 7 days, physical therapist, dietary supervisor, activities (recreation) director; bedroom 23' x 12' + private bath; cost $3,500-6,000 per bed; furnishing $400-600.

Physicians Management, March, 1968, "Medicenters of America"
Now qualify as extended care facilities. Includes X-ray, physical and inhalation therapy laboratory, and pharmacy. Staffed by one full-time MD and nursing complement.

"Hostels in Hospitals", 1968, Meredith, Anderson, et al. UK
30% of patients in teaching hospitals and 36% of patients in general hospitals could be accommodated in "hostels."

Advanced Care Study (Kellogg Foundation)
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86-bed advance care unit; report on facility, staffing, and patient type.

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North Carolina Baptist Hospital; conversion of a former student nurses' residence; includes notes on operating costs (95% patients are out-of-town referrals).

Hospitals JAHA, March 16, 1966, "An Experiment in Minimal Care--Part III"
"Nursing time and costs." Discussion of operating costs; nursing, housekeeping, etc. Rochester Methodist Hospital, Minnesota.

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Queeny Tower at Barnes Hospital, St. Louis; outline architectural report of three dimensional organization. Contains self-care units on upper seven floors of tower over acute care units and doctors' offices.

Weeks, Lewis E., The Complete Gamut of Progressive Patient Care in a Community Hospital, W. K. Kellogg Foundation, Battle Creek, Michigan. (LGA 4994)
Describes physical facilities and operation of 20-bed self-care unit in a 141-bed community hospital. Analyzes role of self-care nurse and reactions of patients to unit. Also gives operating costs per patient day compared to other units in hospital. Lists classification of patients assigned to unit and states reaction of staff to operation of self-care unit.

Griffith, John R.; Weeks, Lewis E.; Sullivan, James H.; The McPherson Experiment, Expanding Community Hospital Services, The Bureau of Hospital Administration, University of Michigan, Ann Arbor, 1967. (LGA-RA 975 P7 G7)

Book length report on same hospital as (LGA 4994).

Symposium of Progressive Patient Care, Hospitals JAHA, January 16, 1959 (LGA-HC120)

Discusses percentage of case load appropriate to self-care unit, problem of flexible staffing patterns and buildings to meet fluctuation in patient census of self-care category, comparative costs (operating) and economics as opposed to other kinds of PPC units in general.

The Progressive Patient Care Hospital; Estimating Bed Needs, U.S. Dept. of HEW, USPHS Publication No. 930-C-2, 1963 (LGA 4449)

Discusses method used to estimate bed needs in PPC hospital through evaluation of patient census based on care requirements. Also includes general discussion of PPC concept.

M of H London, Hospital Building Notes 32 part 2 HOSTEL (Mote')

Description of purpose and physical facilities.

Military Medicine, August 1969

Progressive Patient Care in an Army Hospital.
Col. R. C. Hunter, MC, USA.
Ltc. R. A. Cleveland, ANC, USA.

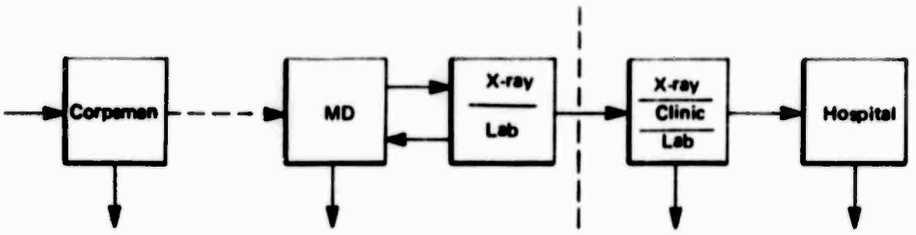
2.4. AMBULATORY CARE SERVICES

2.4.1. THE CONCEPT OF AN AMBULATORY CARE CENTER

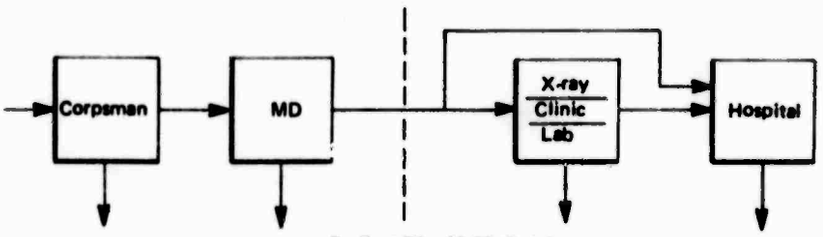
Primary care or ambulatory services represents the perimeter or first point of contact of any health service operation. It is also the early warning system by which those responsible for the health care of a population may become aware of changes in the prevalence and incidence of certain diseases or health problems. Reorganization of primary care offers the most immediate hope of increasing productivity of health professionals and alleviating the shortage of medical doctors. By providing alternatives to hospitalization, ambulatory services provide a primary means of controlling the costs of health care.

We have examined the various procedures by which the military base system provides ambulatory services to active duty personnel. Both screening (triage) and primary ambulatory care differ in the type of staff and facilities available at the point of contact and the responsibilities delegated to the various staff. The particular system in effect at a given base depends on the service, local requirements, and the policies of the base commander, the hospital commander, and the physicians in charge of the dispensaries. Figure 2.4.1 shows four typical systems. In the first model (A), corpsmen provide the primary screening and care; essentially no diagnostic equipment is available. Cases requiring the care of a physician are referred to a base. This model is exemplified by the independent-duty corpsmen on Navy destroyers. In the second model (B), corpsmen perform the primary screening; physicians see those patients not disposed of by the corpsmen. This is the typical modality on Army training bases. A variation of this model (C) includes the availability of diagnostic facilities. In the fourth model (D), physicians see all patients, providing both initial screening and disposition. This procedure is used on Air Force bases. Other variations are possible; for example, in some locations corpsmen may order diagnostics prior to the patient's being seen by the physician.

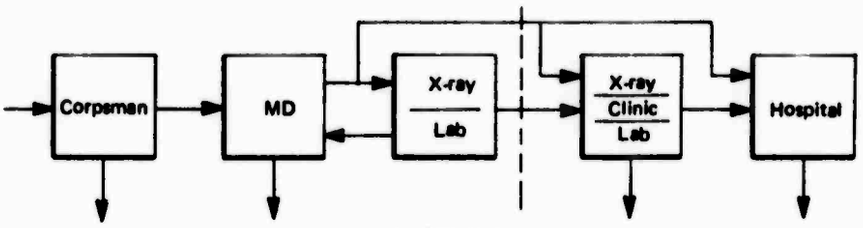
As indicated in Figure 2.4.1, patients may be returned to barracks or duty at a variety of points in the system, depending on policy and the facilities available at the primary screening location.



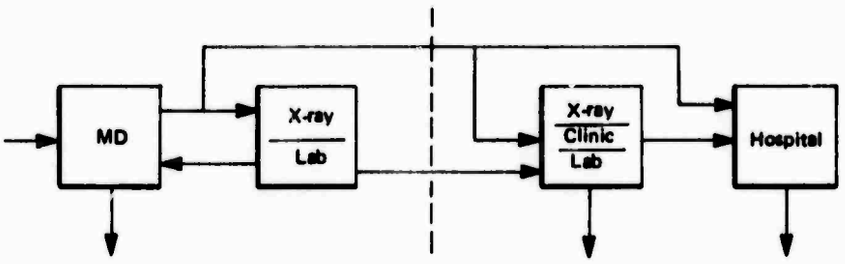
A. Navy Destroyers



B. Fort Dix (A.M. Only)



C. Fort Bragg



D. Norton AFB

FIGURE 2.4.1 PATIENT FLOW MODELS

Our recommendation for ambulatory care on a military base is shown in schematic form in Figure 2.4.2

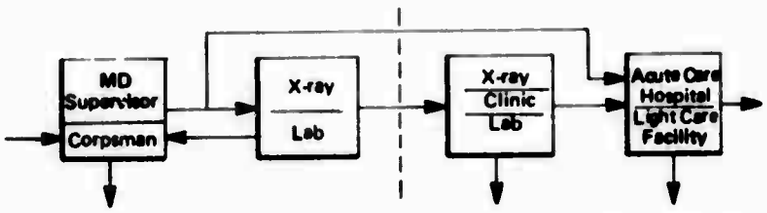


FIGURE 2.4.2 PROPOSED MODEL FOR AMBULATORY CARE ON A MILITARY BASE

Corpsmen will be specially trained to provide the bulk of the primary care in the ambulatory setting, under the supervision and preceptorship of the physician in charge. The ambulatory care center will have sufficient X-ray and laboratory equipment for most of the diagnostic procedures required. To allow sufficient specialization of the corpsmen and utilization of diagnostic equipment in the ambulatory care center, such centers will generally serve at least 6000 to 8000 personnel.* Patients will be referred to the specialized clinics of the acute care hospitals if specialty consultation is needed, or to the diagnostic facilities of the acute care hospital if more complex diagnostics are required. Salient features of the plan are as follows:

- In the case of active duty patients, one physician will be responsible for the services provided by six to eight assistants under his supervision. The key to practical success with this concept is the intent to make the physican the captain of an ambulatory care team.

- The ambulatory care center should be physically separate from the acute care hospital and light care facility in order to give the team a distinct identity; each facility will be responsible for the care of a specified group (generally a population of 6000 to 8000).

* On bases with populations less than about 5000 to be served by an ambulatory care center, a separate facility cannot be justified. However, the concepts can be applied in an outpatient clinic.

- The physician will generally not see patients until they have been seen by an assistant, and then only if (1) the disease or injury is beyond the physician's definition of the competence of each assistant, (2) the physician wishes to instruct, (3) an unusually large load develops, or (4) it is necessary to admit a patient to the acute care hospital (but not, generally, if the patient is only to be sent to the hospital's outpatient department for additional tests or consultation).

- The appropriate facilities for the ambulatory care center depend on the location, but a fully equipped center will contain examining rooms, a pharmacy with a restricted formulary, a laboratory capable of making simple tests, an X-ray unit suitable for chest and extremities, a conference room and library, and a communications center.

- The ambulatory care center staff will include generalist corpsmen (trained at the level of the independent-duty corpsman) and medical specialist corpsmen in orthopedics, podiatry, upper respiratory infections, and dermatology.

The important innovation is not in the physical facility, nor the mere use of assistants, but rather in the concept of a team, headed by a physician working with a supporting staff at the job of providing primary care.

To assure a high level quality of care, the surveillance system should include physician monitoring of process statistics through review of current case histories, spot checks, and meetings with the assistants; and utilization reviews by the hospital commander.

In examining data on primary medical care requirements, we have found that the type of dispensary operations conducted at training bases are in several ways different from those at bases where military personnel have relatively long-term assignments. Moreover, both of these kinds of operations differ from the ambulatory services required by dependents and retirees. We therefore suggest that implementation of our recommendations

take place in four stages: first for active duty personnel at training bases; second for military personnel at other bases; third for dependents and retirees with pediatric, obstetric, psychiatric, and chronic disease problems; and fourth for dependents and retirees requiring general therapy or primary care. We have excluded "specialized" personnel, such as pilots and submariners, from stage two; they constitute a relatively small percentage of the total military population, and the health support services they require are unique.

The benefits of the ambulatory center can be summarized as follows:

- It can be located close to troop areas or to ships, thereby reducing travel time for patients.

- The physician, in his expanded role as supervisor, gains management experience while he is still relatively young; this early experience will provide some basis for identifying potential command and staff officers in the Medical Corps.

- From the standpoint of organization, the ambulatory care center is like a field unit; as such it provides valuable experience for both medical officers and corpsmen.

- Forty percent fewer physicians will be needed to provide care, and the assistants that replace them are less expensive. (This assertion is substantiated later on.)

- Corpsmen and perhaps physicians should experience greater professional satisfaction.

- This organization keeps the majority of patients who have only minor symptoms away from the more complex acute facilities, where the whole focus should be on major problems.

- Control of ambulatory patients is greater in the center than in the hospital environment.

- This arrangement improves continuity of care; the value of continuity of care, however, has not been established.

While offering a number of advantages, the ambulatory care center may also entail certain drawbacks. For instance, some people believe that the quality of care will be diminished because assistants will have had less training; others assert that quality is enhanced because the assistants are not overtrained for their jobs and do not suffer from boredom. Our survey of outpatient records and review of existing studies revealed little evidence of either diminution or enhancement of the quality of care; at best, this issue must be regarded as undecided. Other disadvantages:

- Our survey indicates that when corpsmen provide primary care, there may be more revisits in an episode; this factor was taken into account in developing staffing estimates.

- Since smaller units are more susceptible to the effects of random fluctuations in demand, the ambulatory care center may experience more frequent periods of overloading and underloading than would a centralized facility.

This chapter describes our recommendations for ambulatory services, focusing primarily on those for active duty personnel at bases. Section 2.4.2 presents recommendations for the physical facility, and Section 2.4.3 describes the operations of this ambulatory center, including staffing levels and the anticipated process statistics.

Section 2.4.4 describes the delegation of staff responsibilities under the proposed system and a quality surveillance program, and discusses the training programs required for the recommended staff.

Section 2.4.5 presents our recommendations on changes in facilities and staffing for dental services on military bases; Section 2.4.6 describes our recommendations on extension of the system for ambulatory care services to dependents and retirees.

Costs and benefits of the above recommendations are summarized in Section 2.4.7.

The backup data for our recommendations are summarized in Volume 5, Sections 5.1 and 5.2. This information includes the results of a survey of outpatient records at six military bases, and a review of the relevant literature and previous studies.

2.4.2. AMBULATORY CARE CENTER FACILITIES

2.4.2.1. Base Layout

Each ambulatory care center should, of course, be set up to take into account specific local conditions, including: (a) number of active duty personnel to be served; (b) nature of the mission or miliary activities being conducted, (c) nature of the physical environment, (d) type of military personnel being served (trainees, flying personnel, etc.), and a variety of other factors such as seasonal variations and exposure to infectious disease agents. We can, however, describe a "prototype" ambulatory care center toward which future dispensary designs should move. The prototype ambulatory care center is based on serving an active duty trainee population of 6000 to 8000, or the equivalent of approximately two or three brigades, and handling approximately 250 visits per day. In Stage II (permanent active duty personnel), the population would be 10,000 to 12,000.

We recommend that the following facilities be in the center:

Patient waiting room

One physician's office

One physician's examining room

Four corpsmen offices and examining rooms

Two treatment rooms (including casting facilities)

One office for administration (MSC)

One pharmacy

One X-ray and attached waiting room

One medical records area

One laboratory and specimen drawing room (plus toilet)

One storeroom

One conference room and library

Two patients' toilets and one staff toilet

Optional - one communications room including facilities for facsimile transmission, TV closed-circuit supervision, and TV hospital link.

Figure 2.4.3 shows a suggested arrangement for a dispensary with the above facilities. Table 2.4.1 compares such an ambulatory care center with those currently typical at Fort Dix, which are minimally equipped. The following sections discuss some aspects of the individual facilities within the ambulatory care center.

2.4.2.2. X-ray Facility

The installation of an X-ray room within the dispensary will partly depend on such local parameters as the following:

- type of base
- size of population at risk
- distance from hospital
- extent to which hospital's X-ray facilities are near capacity
- expected volume of referrals from other dispensaries

Whether or not an X-ray facility should be included can be considered on the basis of the following parameters. A typical X-ray room would contain a table and bucky, and an overhead unit rated at 400 ma, suitable for chest and extremity films. Such equipment will handle 90% of radiology orders for patients seen at the center. (See Table 5.1.7.) A completely outfitted room would cost about $50,000 including equipment, shielding, and automatic developer. We estimate that on the average each procedure will

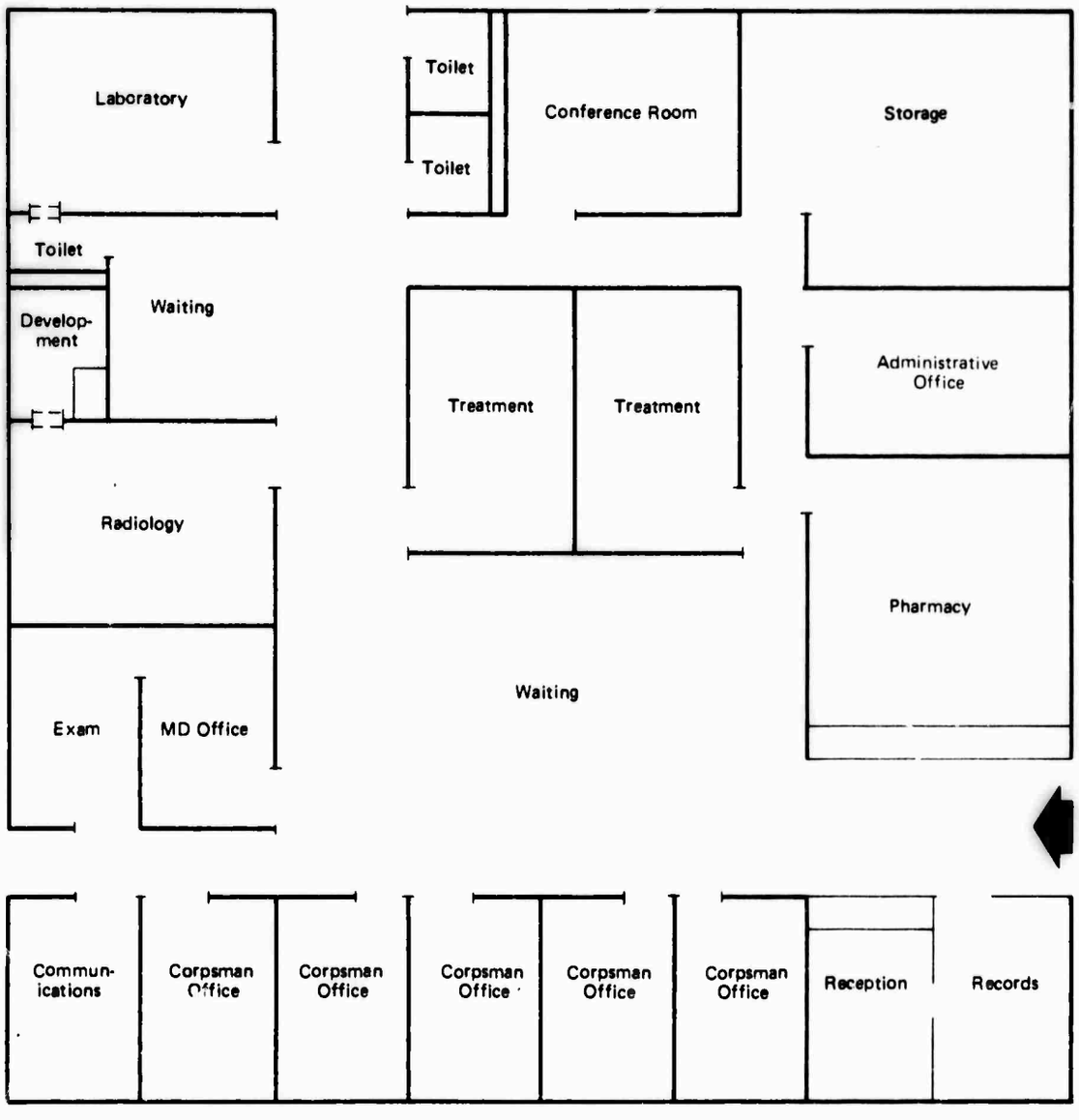


FIGURE 2.4.3 AMBULATORY CARE CENTER UNIT

TABLE 2.4.1

AMBULATORY CARE CENTER FACILITY

	CURRENT (Fort Dix)	PROPOSED I Training Base	PROPOSED II Permanent Personnel
Population served	3,000-4,000	6,000-8,000	10,000-12,000
Visits per day	125	250	180
Facilities			
Treatment Room	1	2	
Pharmacy (Dispensing only)	1	1	
Lab	0	1	
X-ray	0	1	
Examination Rooms	2	5	
Communications (TV)	0	1	
Size (sq. ft.)	2,700	4,800	

require ten to twelve minutes if one technician operates the facility, and approximately seven minutes per procedure with two technicians in the facility. A full day's load would be about 30 procedures with one technician and about 60 procedures with two.

The films will be taken by an X-ray technician and then read by the care center physician. Since X-rays will be taken only of chests and extremities, the majority will be simple to interpret; as discussed in Section 7.5, television transmission of X-rays now appears feasible. Thus, problematic X-rays could be checked by the radiologist at the hospital. The X-ray technician can also be trained to make at least preliminary readings.

The number of patients requiring X-rays will depend on the number of active duty personnel served by the particular ambulatory center and the type of base: a Marine training base, for example, may require more X-rays per patient than an Air Force, Army, or Navy base because of the nature of the training. An ambulatory center that serves 7000 to 8000 active duty personnel can expect on the average at least 20 or 30 patients per day requiring X-rays. (See Table 5.1.6.) This would represent a half-day's load for the X-ray facility and a full day's load for one technician (Table 2.4.2). At this level of activity, the cost per X-ray will be roughly equivalent to one taken in the central hospital, assuming that the load and staff are correspondingly reduced at the hospital. If other ambulatory centers on the base would refer to this X-ray facility (such as is done at Fort Bragg and Parris Island), the load could, of course, be higher.

The major advantage of having the X-ray facility is that patients would not have to be referred to the hospital, with consequent loss of travel and work time; we estimate this to be at least two hours per patient on a large base and frequently much more. In addition, preliminary results of the X-ray would be immediately available to the attending corpsman or physician so that immediate disposition could be made.

A slight loss in efficiency may be incurred in placing an X-ray technician in the ambulatory center instead of at the hospital, because fluctuations will be somewhat higher in the ambulatory center and load per man lower

TABLE 2.4.2

TYPICAL UTILIZATION OF X-RAY UNIT
IN AMBULATORY CARE CENTER

Population at Risk	3,000	5,000	8,000	10,000	13,000
Visits Per Day	100	150	250	300	400
Number of X-rays per Day	10	15	25	30	40
Utilization					
X-ray	20%	25%	40%	50%	65%
Technician (one)	35%	50%	85%	100%	
Technician (two)	20%	25%	40%	50%	65%

These figures were developed by extrapolating and interpolating the measured process statistics assembled in a survey of outpatient visits, described in Section 5.1.

than in the hospital. Any such (small) decrease in efficiency will be more than offset by the savings in the time of patients who do not have to travel to the hospital and who, in addition, receive immediate care and disposition. It may not be possible to replace the X-ray unit completely in the hospital; we thus estimate that half the capital cost, or $25,000, is incremental.

To summarize, an X-ray facility is in general cost-justified in the ambulatory center when the population served results in at least 25 patients per day requiring X-rays. On the average, about 10% of patients require X-rays; therefore, if an ambulatory center serves a population of at least 7000 to 8000 troops, the installation of an X-ray facility in the center will generally be justified.

2.4.2.3. Laboratory

In the coming decade laboratory services will become increasingly automated. Since the transportation of specimens is not a major problem, it is most efficient for all but the simplest tests, to collect specimens, spin them down, and transport them to a central facility for determination. Thus, we recommend that the centers be equipped with minor lab facilities, mostly for the handling of collected specimens, and with an area which would receive and distribute the results from the central hospital. The center will have a microscope and equipment for urinalyses, smears, gram stains, white counts, and microhematocrits. This will enable the staff to make immediate decisions regarding referral and return visits. If development of a fast analyzer as described in Section 7.6 is successful, then most blood tests could be performed there as well. The laboratory will be staffed by one corpsman, who will attend to all the handling of the specimens, information, and transportation.

2.4.2.4. Pharmacy

Most dispensaries are currently equipped with dispensing pharmacies which carry a standard line of drugs for prescriptions. The equipping and stocking of these pharmacies operate well, and we would recommend that they continue as at present. This is appropriate because most patients who receive medication at the care center will require only simple, standardized, generally prepackaged medication; any patients requiring more extensive medications will have been referred to the hospital either for specialty consultation or for admission. Once the center is operational, different and more

complex drugs may be added. The space now generally provided to pharmacies would adequately handle any such increase.

2.4.2.5. Communications Room

We believe it would be useful to include a communications room in at least one ambulatory care center of the prototype base health care system, on an experimental basis. The communications room would have provision for the following equipment:

(1) TV link to base hospital. Since television transmission of X-rays appears now to be feasible, the more complex X-ray films could be transmitted to the hospital for immediate review by the hospital radiologist. In addition, it will be possible in many instances to obtain consultations from specialists at the hospital via the television link.

(2) Videotape TV. As discussed later, a videotape unit can be a useful technique for recording corpsman-patient visits, partly as a surveillance mechanism but more importantly as a technique for instructing corpsman on improving their history taking, examinations, and diagnostic skills. One videotape unit can be used in several ambulatory care centers and the hospital as well.

(3) Records and results. A computer-controlled teletype can be used for transmitting and recording records and patient test results. Computer-aided diagnosis may be a useful adjunct in the future.

Installation of such a communications room will require a full-time technician to maintain the equipment. This technician will be in addition to the staff discussed later.

2.4.3. AMBULATORY CARE CENTER OPERATIONS

2.4.3.1. Staffing

The three military services show different approaches to the staffing of ambulatory facilities; this stems both from their general approach and also the specific problems on any base. There is a tendency to use corpsmen more extensively in the Army and Navy and less extensively in the Air Force. The Navy corpsman on a destroyer, for example, now clearly carries a large amount of responsibility for diagnosis and treatment and often operates independently. Our projected staffing for a prototype ambulatory care center is based on the Army Staffing Guide and the actual staffing patterns we have found in the Army and the Navy (Table 2.4.3).

Table 2.4.3-A indicates staffing levels versus population at risk and anticipated daily load, based on current typical assignment of duties; the figures are extrapolations of the staffing shown for a troop dispensary in the U.S. Army. From our observations, this represents a reasonable quality of care delivered efficiently. The level of staffing for the larger centers compares with the staff of 23 to 27 recommended for complete dispensary care to 5000 to 10,000 troops not otherwise provided with primary medical care, in theaters of operations at the rear of field (dental care and ambulance and truck drivers excluded). (Ref: TOE 8-500G, Personnel Allowances, 30 November 1966.) Table 2.4.3-B presents our recommended staffing for the ambulatory care center. We have substituted corpsmen acting as assistant physicians in place of some of the physicians. As discussed later, the responsibilities of the various members of the staff within this pattern will be totally changed.

By comparing Parts A and B of Table 2.4.3, one can see that the largest percentage reduction in physicians is indicated for the center that has 250 visits per day, or a population at risk of about 8000; the number of physicians is reduced from three to one. Initially, it may be desirable to staff the center with two physicians; as experience is gained by both physicians and corpsmen in the team approach to health care delivery, the number can be reduced to the recommended one physician. Also, as discussed above, an X-ray unit becomes justified at this level, as well as some specialization in corpsmen.

TABLE 2.4.3

AMBULATORY CARE CENTERS - STAFFING
(Training Base)

Population at Risk	3,000	5,000	8,000	10,000	13,000
Visits per Day	100	150	250	300	400
A. Staffing - Current*					
Physician	1	2	3	4	5
Corpsman	3	4	5	6	7
Master Sergeant	0	0	1	1	1
X-ray Technician	-	-	1	2	2
Lab Technician	-	-	1	2	2
Pharmacist	1	1	1	2	2
Records Clerk	1	1	2	2	3
Total Staff	6	8	14	19	22
B. Staffing - Recommended					
Physician	1	1	1	2	2
Corpsman	3	5	7	8	10
Master Sergeant	0	0	1	1	1
X-ray Technician	-	-	1	2	2
Lab Technician	-	-	1	2	2
Pharmacist	1	1	1	2	2
Records Clerk	1	1	2	2	3
Total Staff	6	8	14	19	22

*Based on Staffing Guide for U.S. Army Medical Department Activities, 616-557 Pam 616-557

Thus, a facility that serves 6000 to 8000 active duty personnel is in a sense optimal, since it allows maximum substitution of corpsmen for physicians and will have sufficient volume to justify staff specialization and use of some specialized facilities, while maintaining an integrated team approach to a specific population at risk. Table 2.4.4 presents a brief description of the levels, duties, and responsibilities of the staff in the care center. The specific duties and responsibilities of the physician and of the different medical corpsmen are discussed in detail in Section 2.4.4.

2.4.3.2. Ambulatory Care Center Services

The ambulatory center would be operated as follows:

(1) Hours of service: 7 a.m. to 6 p.m. Monday through Friday; 7 a.m. to 12 noon Saturday.

(2) Routine (sick call) and emergency walk-in service will be provided in the morning, and emergency and follow-up visits will be primarily served in the afternoon, as is current practice. Special consultations and out-of-hours care will be provided in the base hospital, as now.

(3) Most simple lab work will be performed in the center. More complex determinations will be ordered and drawn or collected in the ambulatory center and sent to the hospital for analysis at central laboratory facilities. Special or infrequent diagnostic work, such as complex X-rays and EKG's, will be performed at the hospital central facilities.

(4) Records and prescriptions will be handled in the ambulatory center.

(5) Specialty consultation will be performed at the hospital at the specialty clinics; primary and follow-up care will be provided in the ambulatory center.

TABLE 2.4.4

DUTIES OF CARE CENTER STAFF

Position Title	General Duties
Physician	Supervises and acts as preceptor and consultant to corpsmen and renders surgical and medical treatment and diagnosis as backup to his corpsmen staff
Medical Corpsmen	Provide general diagnosis and treatment to active duty personnel under physician's supervision
Medical Service Corps Officer, Master Sergeant or Master Medical Sergeant	Provides general supervision in the dispensary
X-ray Technician	Takes and develops X-ray films of chest and extremities
Lab Technician	Takes and prepares laboratory specimens
Pharmacist	Dispenses drugs as ordered by corpsmen and physicians
Records Clerk	Maintains patient records and files

(6) Simple ambulatory treatments including podiatry treatments, suturing, setting of simple fractures, and other ambulatory orthopedic procedures and treatments will be done in the center. Patients who cannot be returned to barracks may be sent to the hospital or to the light care facility.

We expect the prototype ambulatory care center to operate in approximately the manner described below, although the details will differ somewhat from location to location, the particular service, the nature of the base, and the kind of military personnel being served.

Of the estimated 250 visits per day, between 50% and 60% or 125 to 150 will be at morning sick call, which is normally compressed within a three-hour period. The remainder will consist of visits for treatment of complaints such as orthopedic and podiatry ailments (about 20% to 30% or 50 to 75 per day), and sick call visits during the remainder of the day (about 20%).

Corpsmen will handle most of the screening, primary care, certification, and disposition of patients. The average number of patients per corpsman at sick call will be 12 to 15 per hour; each corpsman will therefore handle a total peak sick call load of 35 to 45 patients within a three-hour peak period. Thus, four screening corpsmen will be able to handle adequately the estimated peak sick call load of 125 to 150 patients. In addition to the primary screening and disposition, some patients will of course be sent for treatment in the treatment rooms, for X-rays or lab tests, for medication from the pharmacy, and referred to the ambulatory care center physician.

We estimate that, on the average, the physician will be consulted by the corpsman for 10% of the patients at sick call, and that the physician will see up to an additional 10% in more extended consultation and treatment. We estimate that the sick-call consultations will average three minutes, and that the extended consultations will average ten minutes. Thus, the physician will be consulted for a maximum of five hours per day. Table 2.4.5 summarizes the expected process statistics.

TABLE 2.4.5

AMBULATORY CENTER PROCESS STATISTICS

	CURRENT (Ft. Dix)	PROPOSED
Population at Risk	4,000	8,000
Visits per Day	125	250
Percent Seen by Medical Doctor	85%	20%
Referrals to Hospital	20-25%	10%
Sick Call		
Number at morning sick call	85	150
Screening Corpsmen	1-2	3-4
Avg. Contact Time per Patient:		
Corpsman	2-5 min.	5 min.
Physician	2-4	3
Total	5-8	6

2.4.4. STAFF RESPONSIBILITIES

2.4.4.1. Delegation of Corpsman Functions

Tables 2.4.6 and 2.4.7 show the suggested delegation of functions to nonphysicians with reference to problem area history-taking, physical examinations, and initiation of laboratory studies. For example, the physician will take histories for problems of stiffness of the neck, pain in the chest, shortness of breath, abdominal pain, and for about half of the patients with ill-defined symptoms or psychiatric symptoms. (About 10% of patients will have these problems or symptoms that require a physician.) In contrast, the nonphysician will complete history forms relating to extremity injury or pain, colds, sore throats, skin rashes, heartburn, diarrhea, venereal disease, ear pain, headaches, and so forth; these account for about 90% of patient visits. We estimate that the physician will also be consulted for about 10% of these patients.

Nonphysicians would be expected to be able to examine extremities, skin, ear, nose and throat, and the genitourinary tract. A physicians' appraisal would be necessary for examinations of the chest, abdomen, and certain aspects of ophthalmological examinations. While the nonphysician may initiate requests for urinalysis, white counts, differentials, cultures, and X-rays of the chest and extremities, the physician will review all abnormal lab results (except for potassium tests), all chest X-rays prior to dismissal of the patient, and all other X-rays.

The two general, independent-duty, ambulatory care specialists represent the type of personnel now being trained by all services for independent duty aboard ship, in isolated installations, or for combat support duty in southeast Asia. As indicated, one of these independent generalists would

TABLE 2.4.6

DELEGATION OF RESPONSIBILITY BY PROBLEM AREA

A. Seen by Physician

Pain/Stiffness of Neck
Shortness of Breath
Chest Pain
Stomach Pain
Rectal Problem
Weight Loss
Eye
Fainted
Ill Defined Vague Complaint/Nervous, etc.

B. Seen by Corpsman

Injury to Extremity/Joint
Pain in Extremity
Back Strain/Pain
Cold/Cough/Sore Throat
Skin Problem
Diarrhea
Loss of Appetite
Gas/Belching/Heartburn
Pain or Difficulty Urinating
Swelling/Pain in Testicle
Headaches
Ear

TABLE 2.4.7

DELEGATION OF PHYSICAL EXAMINATIONS

Physician	Corpsman	
	x	Vital Signs (Temperature, Blood Pressure, Pulse)
	x	Extremities
	x	Skin
x		Eye
	x	Ear, Nose, and Throat
	x	Upper Respiratory Tract
	x	Genitourinary
x		Cardiovascular
x		Abdomen

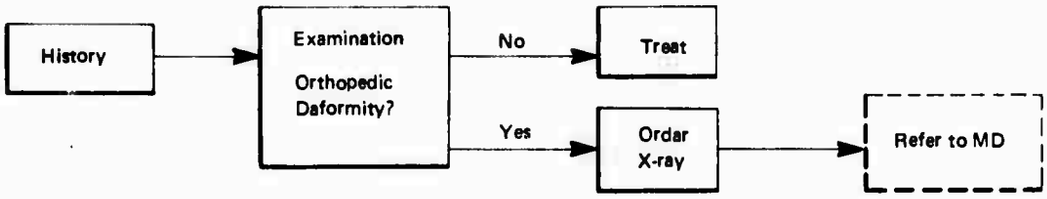
serve in a triage function; the other would provide direct care to those patients referred to him by his associate. The other patients, on the basis of specific standing orders, would be assigned to sub-specialists in the field of musculoskeletal disease (one each in orthopedics and podiatry--with a major in one field and a minor in the other); a specialist in respiratory diseases; and a specialist with training in skin diseases and problems of genitourinary and gastrointestinal nature. In addition to the six specialists, a seventh corpsman, trained at the level of the dispensary attendant, would be assigned by the physician supervisor to assist in screening or treatment.

2.4.4.2. Examples of Corpsman/Physician Team Operation

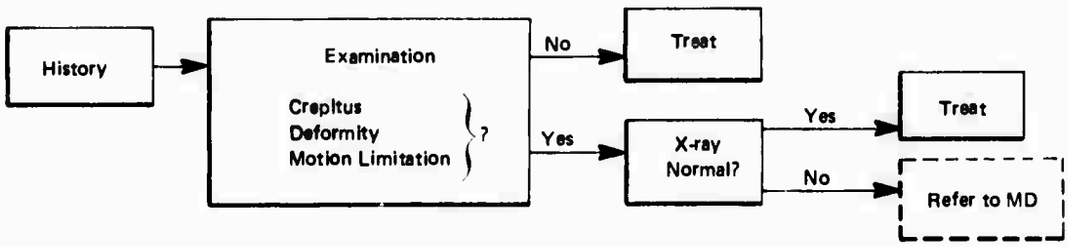
One approach toward defining the specific roles of corpsmen and physicians in ambulatory health care would be to compile an inventory of the most common cases that would be handled in the center. This list would itemize the specific contents of the histories, the nature of the physical examination needed, and the X-rays and other tests that would be performed before (a) the patient saw the physician, (b) the corpsman managed the case, or (c) the corpsman and physician dealt with the problem together. A complete inventory would also describe the standing orders for treatment, the amount and type of medications that could be dispensed by the corpsman, and when a revisit should be scheduled for the patient. Finally, it would have to specify the criteria under which a physician should be notified by the corpsman, should see the patient, and should make further decisions about the management of the case.

Such an extensive treatment of the subject would, of course, be impractical for the purposes of this report. In lieu of a complete inventory, we present below ten typical case histories that are based on our review of records from six military installations. (See Section 5.1.2.) These describe in sequence what would be done, by whom, and how each case would be evaluated. Three of the cases are diagrammed in Figure 2.4.4 to show the decision points and options. For the types of problems abstracted from the records, these histories demonstrate the basic principles of defining the

1. **Foot Soreness (callus)**



2. **Finger in Door**



3. **Sprained Knee**

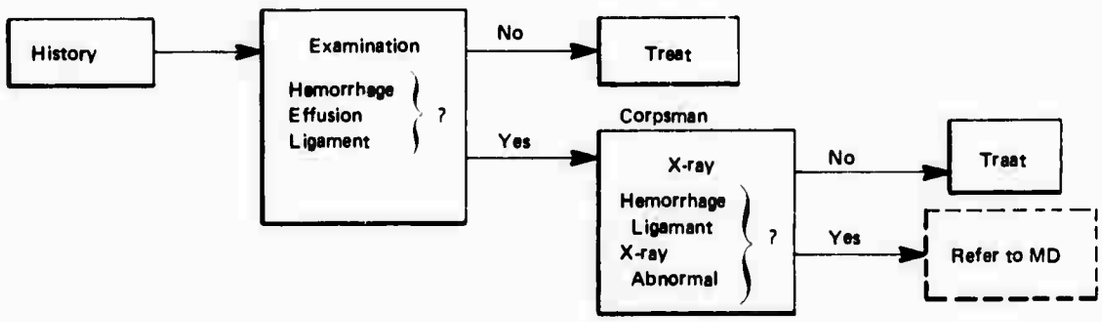


FIGURE 2.4.4 EXAMPLES OF CORPSMEN – MD RESPONSIBILITIES

area, standing orders, and criteria for referral. All patients are assumed to be active-duty male military personnel between the ages of 18 and 40.

Case 1: Chief complaint: Knee sprained in an accident. Function of corpsman: To take a complete history of the incident when knee was injured, circumstances of injury, any prior history of previous injury to the joint, presence of pain, radiation of pain, nature of pain, any trouble with weight bearing. Physical examination: corpsman will note presence or absence of effusion, hemorrhage, test for intactness of the ligaments, note range of motion and any limitation. If hemorrhage, effusion, or question of ligamentous tear exists, he will order X-rays. In the absence of hemorrhage or no evidence of damage to ligament, patient may be treated with supportive measures - elevation, elastic bandage, or aspirin; given light duty; and asked to return the following day. Presence of hemorrhage, X-ray abnormalities, or suspicion of ligamentous injury are criteria for referral to physician.

Case 2: Patient has sore feet (obvious callus formation on cross metatarsal arch). Corpsman obtains history, determines duration of callus, past history of other foot problems, any change in shoes, duty, etc., and manages problem. Refers to physician only if question of underlying orthopedic deformity; if so, X-rays are ordered in advance.

Case 3: Chief complaint: Finger caught in closing door. Corpsman's function: Describes nature and time of accident, lists history of any other injury incurred, examines finger, records any loss of function or sensation. Standing orders indicate that if any crepitus, obvious deformity, or limitation of motion exists at the joint space, an X-ray will be taken. If X-ray is normal as interpreted by the corpsman, the patient will be dismissed with appropriate dressing and with whatever duty excuse is necessary, to return in two days. The doctor will check the X-ray during the same day as part of the surveillance program. Any disagreement with interpretation will require recall of the patient.

Case 4: Chief complaint: Foot pain. Corpsman's history will document onset, nature of pain, and relationship to activity, change of shoes, etc. In physical examination the corpsman determines presence of orthopedic deformities. If none, refers to podiatry.

Case 5: Chief complaint: Peeling and itching of the skin on both feet. Corpsman will examine the patient, note duration of complaint, previous history of similar problems, nature and extent of peeling, presence of vesicles, and describe condition of toes, including fissures and any evidence of cellulitis or lymphangitis. Under standing orders he will, if in doubt, do a skin scraping (potassium preparation to identify fungi). Otherwise, under standing orders, he will dispense appropriate medications.

Case 6: History of pain on urination for three days. Corpsman will take complete history: nature of urinary tract symptoms, frequency, dribbling, type of pain, discharge, radiation of pain, past history of previous urinary tract problems. He will examine patient for any evidence of urethral discharge. Under standing orders, he will obtain a urinalysis. If urinalysis is completely negative, he will suggest forced fluids and provide symptomatic treatment. He will also obtain previous history of prostatitis or venereal disease, infections, and inquire with regard to sexual contacts, etc. In the event that the urinalysis is positive, corpsman will initiate a urine culture in the laboratory, take a drug history with regard to sensitivity, and refer patient to physician.

Case 7: Chief complaint: loose bowel movements. Corpsman will establish duration of diarrhea, presence or absence of any vomiting, inquire regarding nature of stools, bleeding, and presence or absence of pain. Corpsman will take a history of food intake, question any source of "food poisoning" from history of onset, etc. He will examine abdomen for tenderness and record nature of bowel sounds. In the absence of temperature, severe abdominal pain, or tenderness, he will dispense supportive medication and schedule a revisit if necessary. Physician will not need to see patient.

Case 8: Upper respiratory infection, two days' duration. Corpsman will take temperature, examine ears, nose, and throat, including presence of lymphadenopathy and tenderness. In the absence of fever or other appropriate signs, he will dispense supportive medication for URI and instruct patient to return as needed.

Case 9: Cough of two days' duration. Corpsman will obtain information about duration, time of onset, nature of the cough, type and color of sputum produced, past history of respiratory infections, etc. He will also inquire

into past history of allergies, asthma, or hay fever. If patient has cough which is productive of yellowish sputum, corpsman will listen to the breath sounds; if in any doubt, X-rays will be taken and reviewed by the physician. If auscultatory findings are normal, patient will be given cough syrup and drying agents and asked to return in one day. Duty excuse may be necessary, depending on nature of activities.

Case 10: Patient with onset of cough, general malaise. Corpsman will take history as above. If oral temperature exceeds 100 degrees, standing orders require physician to see the patient. Corpsman will order an X-ray examination and listen to the chest. At the time of physician consultation to determine disposition, corpsman will be present to review the physician's findings to compare with his own.

2.4.4.3. Surveillance

One of the primary requirements of a surveillance system in health care is to monitor the effectiveness of the system itself, once it is established. To be effective, any surveillance system must possess the following characteristics:

(1) Criteria must be clearly specified upon which judgments will be made regarding the acceptability or nonacceptability (or other intermediate gradations) of performance. These criteria must be stated in objective, unequivocable ways and be based upon the existence of measurement instruments which provide objective results.

(2) Systems must use random-sampling methods in order to produce statistical inferences regarding the entire population, since efficiency demands examination of a sample of events or occurences rather than the entire universe of activities. The system must also permit intentional nonrandom sampling when indicated in order to confirm suspected changes by increasing the number of events sampled from one area, etc.

(3) Data collection, including the instruments or forms which are used to generate data, must be consistent with the flow of work activities and not be overly cumbersome.

(4) Since the surveillance system is designed to facilitate and improve the operations of those who are being surveyed, it is important that those who are the subject of the surveillance be actively and deeply involved in the review of data as well as, to some extent, in modifications of surveillance systems so that they have the opportunity to interpret the system as being for their benefit, rather than a form of external interference designed to detect untrustworthy or dishonest persons.

In general, two types of measurements can be made:

The processes of care (i.e., things that are done by health professionals to patients) and a determination as to whether these are consistent with the "best" or at least "acceptable" practices;

The outcomes of medical care, or measures of the end results of these activities.

In both cases, since an evaluation is being conducted, the reasons for certain criteria or endpoints must be clear to all those involved.

In the process analysis of medical care, use of certain medications which carry a higher risk or undesirable reactions, ordering of certain radiologic procedures in excess of that anticipated, transfusion of single units of blood, etc. are examples of the type of information to be obtained. The majority of outcome measures currently used reflect the extent to which the patient's disease is cured, disability is minimized or eliminated, discomfort and dissatisfaction alleviated, and, of course, death and disease are prevented in the population. In ambulatory care, morbidity and mortality rates usually are too crude to measure the activities that are occurring. Therefore, the

measurement of disability, dissatisfaction, and discomfort, plus the utilization of process measurements for medical care, tend to be the primary methods of auditing the quality of care.

The following are the types of activities to be covered by a surveillance system:

(1) Waiting time of patients between registering and being seen by corpsmen, as determined by periodic monitoring.

(2) Time spent by corpsmen with patients (specific to the type of problem presented), determined by periodic estimates.

(3) Revisits, laboratory tests, and X-rays ordered by a corpsman, including the appropriateness of the tests for a specific condition. We recommend that a 5% sample of each corpsman's cases be reviewed periodically by the medical officer in charge. Any ordering of tests or diagnostics which, in the judgment of the physician, are inappropriate will be examined.

(4) Certifications made by the corpsmen (i.e., excuses from duty, light duty, etc.) will be sampled and examined carefully. Company commanders or other military officers must be assured that the delegation of this responsibility to corpsmen does not lead to bribery or nonprofessional behavior.

(5) Several new techniques involving the auditing of patient care could be utilized. In recent experiments by Lewis and Resnick, television cameras have been used to monitor, on videotape, the interactions between nurses and patients. These can subsequently be played back and a random sample observed at the convenience of a surveillance group. In this case, it should be pointed out that to avoid a "big brother" syndrome, the corpsman should be present and have

an opportunity to learn something about the nature of his interactions with patients rather than feel that he is being spied upon by those in authority.

2.4.4.4. Staff Responsibilities and Training

2.4.4.4.1. Physician/Supervisor

The physician/supervisor has the following duties:

(1) Administers emergency medical treatment to patients who have serious medical illnesses before they are transferred to more specialized facilities.

(2) Performs triage functions to determine the extent and nature of illness or injuries of patients referred to him by corpsmen.

(3) Engages in the practice of primary medical care, including the performance of minor surgery (incision and drainage of abcess, sutures, lacerations, etc.), or assumes a supervisory role if these functions are delegated to surgical technicians.

(4) Is generally responsible for all health-related activities at the dispensary.

(5) Holds weekly staff conferences with all corpsmen to review a 5% random sample of all recorded corpsmen activities.

(6) Conducts teaching patient-care conferences in order to review medical pharmacology, techniques of physical examination, and differential diagnoses.

(7) Assumes responsibility not only for the care of individual patients but also for the surveillance of medical problems

within a population (through epidemiologic surveillance techniques carried out by preventive medicine corpsmen).

(8) Maintains quality control over laboratory determinations through the use of "unknowns" provided by the base hospital laboratory.

He must have the following skills and knowledge, the last four of which should be taught as part of each military physician's basic military training:

(1) Must be a graduate of an accredited medical school.

(2) Must have a straight medical internship or, if a rotating internship, a year of internal medicine.

(3) Must know the general principles and purposes of medical records.

(4) Must be familiar with methods underlying surveillance/control systems.

(5) Must have elementary knowledge of pedagogical techniques involved in continuing education programs for dispensary personnel.

(6) Must have taken introductory course in organizational management and problems associated with team care and primary care.

The physical requirements for the physician/supervisor are the same as for all medical officers.

The mental requirements of the position include emotional stability and a considerable degree of adaptability and versatility. Effectiveness and

skill are also needed in interpersonal relationships to obtain the cooperation, respect, and confidence of members of the dispensary team.

When a physician has the above prerequisites, he will receive in addition a two- or three-week training program which has the following content:

(1) Fundamentals of epidemiology.

(2) Review of the nature of medical care services required for the type of medical populations being served.

(3) A review of pedagogical techniques for improving effectiveness of teaching.

(4) A brief course in principles of organization and management of medical teams.

(5) Practice sessions in group dynamics.

(6) Laboratory experience in epidemiologic problems, quality control, audit, etc.

2.4.4.4.2. Generalist Corpsmen

The generalist corpsman will be trained at the present level of the (Navy) independent-duty corpsmen. He must have two years of additional on-the-job training in a dispensary setting.

Under a physician's supervision, his responsibilities are as follows:

(1) Takes histories, orders lab tests and X-rays, and prescribes treatment to active-duty personnel.

(2) Excuses (certifies) patients from duty.

(3) Refers to the outpatient clinics for consultation and for admission as required.

(4) Calls upon the local physician for immediate consultation when needed.

2.4.4.4.3. Specialist Corpsmen

As we have indicated above, three major types of specialist corpsmen are required for active-duty ambulatory centers: orthopedic/podiatry specialists, respiratory specialists, and dermatology/gastrointestinal specialists. Related training programs already exist for the first two specialties, in the training programs for orthopedic and podiatry specialists and in the training for inhalation therapists. The third corpsmen specialist group--dermatology/GI--has no direct counterpart currently, either in DOD or civilian training programs. In each case new training programs will need to be devised, to provide specialists trained at the proposed intermediate levels. We estimate that perhaps ten to twelve weeks in each of the specialty areas will be sufficient. The content of such curricula will differ from those now used: they will deemphasize inpatient nursing care procedures and emphasize the types of diagnostic and management skills and information required for ambulatory care, as we have described.

The graduates of such training programs would be assigned for periods of supervised training in functional ambulatory care units, where existing ambulatory care specialists of their particular type were working.

Since modifications in the training programs are bound to be made as experience is gained in the new system for provision of primary ambulatory services, this initial development and implementation of the specialist corpsman system should probably be viewed as an R&D project, and a very suitable one for the prototype base hospital. Included in the R&D aspects would be analysis of the curriculum for the training programs; job descriptions; standing orders; and guidelines for managing problems and diagnoses in each particular area.

2.4.4.5. Impact of Reorganization

2.4.4.5.1. Reduction of Physicians

To test our conclusions, we have reviewed the impact that the preceding recommendations would have. Table 2.4.8 summarizes the current and projected

TABLE 2.4.8

STAFF REQUIREMENTS FOR ACTIVE-DUTY AMBULATORY SERVICES

LOCATION	ACTIVE DUTY POPULATION AT RISK	ACTIVE DUTY VISITS PER DAY	CURRENT STAFFING			PROPOSED STAFFING			MD REDUCTION	
			MD'S	CORPSMEN	TOTAL	MD'S	CORPS-MEN	TOTAL	NO.	PERCENT
Fort Dix Dispensaries	25,000	750	7	40	47	5	42	47	2	25
Mayport	350 (+1500)	55	2	4	6	1.5	4.5	6	0.5	25
NATTC	3,000	100	2	11	13	1	12	13	1	50
NAS	4000 + 5500 Civilians	250 (50 Dependents)	6 (+7)	36 (+16)	42 (+23)	3	39	42	3	50
Cecil Field	500 + Dependents	200 (100 Dependents)	6 (+13)	33 (+65)	39 (+72)	4	35	39	2	33
Norton Military Clinic	7,000	52	2/25	NA	2 +	1/15.5	1	2 +	1/9.5	50/25-50%

staffing at dispensaries and hospital clinics providing ambulatory services to active-duty personnel at the three bases that we have studied intensively: Fort Dix, Jacksonville Naval Air Station, and March Air Force Base. We have assumed that the total staff providing health care services will remain the same in each instance. Comments on some of these locations follow.

Fort Dix. Physician utilization and the provision of primary ambulatory services to active-duty personnel are quite efficient at Fort Dix; one or two physicians attend sick call at each dispensary for 2 1/2 to 3 hours on the average. Since a total of 14 physicians perform this service, approximately 40 hours per day are devoted to primary ambulatory care for active-duty personnel by physicians in the dispensaries.

Furthermore, patients who come to the dispensary in the afternoon and cannot be cared for by corpsmen are sent on to the hospital. For every 100 patients seen by a physician in the morning, our patient record survey at Fort Dix shows that about 22 additional patients are sent to the hospital emergency room. There, physicians devote an additional 9 hours per day to providing primary care.

Only about 4% of the patients at Fort Dix dispensaries received X-rays. (See Table 5.1.6.) An X-ray unit would be justified, however, if other centers could refer to one or two central care centers.

Under our proposed reorganization of ambulatory services for active-duty personnel, we estimate that the number of active-duty patients seen by physicians can be conservatively reduced from approximately 85% (including those seen at the hospital) to under 20%. We further conservatively estimate that this will reduce the time required by physicians by at least 25%. (See Table 5.1.2.) Thus, at Fort Dix the number of physicians required to provide ambulatory services to active-duty personnel will be reduced from approximately seven to five.

To realize the maximum benefit of this reorganization, it would be desirable to combine some of the dispensaries and reduce the number from nine to four or five. As discussed above, the prototype center size would be roughly twice that of the typical current dispensary, and would have one physician serving as supervisor/preceptor to approximately eight or ten

corpsmen; each center would provide services to approximately 7000 to 8000 troops, or two brigades.

Mayport. The active-duty population at Mayport consists of 450 men permanently assigned to the Mayport station, plus 15,000 men on ships who visit Mayport periodically. The Mayport dispensary has seven full-time physicians plus four part-time physicians (from the ships) who spend about 75% of their time at the dispensary, providing an effective physician strength of ten.

The dispensary is divided into a dependent side, which sees about 200 patients per day, and a military clinic side, which sees about 40 active-duty males plus another 15 dependent males per day. The military clinic is staffed with two physicians and four enlisted men. Ninety percent of the military patients are from ships in port and are referred from the corpsmen on the ships. The supervisor of the Mayport Dispensary believed that most of these should be seen by a physician, since they had already been screened by the ships' corpsmen; he estimated that perhaps one-third of the patients could be handled by a corpsman.

With greater emphasis on corpsmen providing ambulatory care, perhaps 15 to 20 of the 55 patients could be very adequately handled by a corpsman. This would reduce the load to 35-40 that would be seen by a physician, but this is still a fairly heavy load for one physician. It might be possible to reduce the staff by one physician in the clinic, because backup would be available in the remainder of the clinic. However, most of the patients would have been referred by corpsmen, as discussed above, so they would probably not represent the average patient seen at sick call; it may therefore be advisable to retain two physicians in this clinic. For analytic purposes we strike a balance and estimate that one-half of a full-time equivalent physician may be replaced, by reorganization of ambulatory services.

Naval Air Station, Jacksonville. The dispensary at the Naval Air Station main base serves 5500 civilians and about 4000 active-duty personnel (roughly half of which are associated with squadrons and half are permanently based). The number of visits per day averages about 250, of

whom 80% are active-duty. Currently, the staff includes six permanently assigned physicians plus an average of seven from squadrons, and 36 permanently assigned corpsmen plus an average of 16 from squadrons. We estimate that three permanent physicians could adequately handle this load, particularly with the extensive backup.

Cecil Field Naval Air Station. The dispensary at Cecil Field has approximately 200 visits per day, slightly over half of which are by dependents. In addition to the six permannntly based physicians, there are an average of thirteen physicians from the squadrons. There are 33 permanently assigned enlisted personnel plus approximately 65 from the fleet. We estimate that one physician acting in a supervisory role could adequately handle the active-duty load. If no change is made in providing services to dependents (every dependent must be seen by a physician), three physicians should be adequate to handle this load. It would appear, therefore, that four physicians could handle the total load of active-duty and dependent visits at Cecil Field.

Norton Air Force Base. With an active-duty base strength of 7135, Norton AFB has about 110 active-duty visits per day. The two physicians in the Flight Surgeon's office see about 34 patients per day, of whom 26 are active-duty personnel. A large fraction of visits are physicals. The military clinic, which is also staffed with two physicians, has about 52 patients per day. In addition, about 30 active-duty visits are made to the emergency room and the General Therapy clinic.

Under our proposed reorganization of ambulatory services, the military clinic could be staffed by one physician and one physician assistant. Because of the immediate availability of physician backup at Norton Dispensary, this appears to be quite feasible.

The reduction in number of physicians providing ambulatory services to active-duty personnel will range from approximately 25% at recruit training bases, where considerable use is currently made of corpsmen, to as high as 50% at location where corpsmen are currently used only sparingly for primary care. On the average, we estimate that 40% of physicians can

be substituted under our recommended concept for provision of ambulatory services.

2.4.4.5.2. Cost Savings

To compare costs of operation under our proposed organization for active-duty ambulatory services with those of the system now in effect, we have listed staff costs under the two systems (Table 2.4.9). Referring to Section 2.4.3. and Table 2.4.3, we are proposing to replace physicians with corpsmen who are somewhat more highly trained than at present. At an ambulatory care center serving 8000 personnel, there will be an annual reduction of $11,000 (Table 2.4.9), primarily because staff costs are about $5000 more for a physician than for a highly trained corpsman. This difference is offset to a great extent by the additional training required by the corpsmen to upgrade their capabilities.

In summary, we do not expect any major saving, under current salary scales, by only implementing the reorganization of services for active-duty personnel. The saving will be significant, however, when the proposed system is extended to dependents and retirees (Section 2.4.6.), or if the difference in staff cost between physicians and enlisted men widens. As indicated in the above section, the system will operate with fewer physicians; in the case of active-duty personnel, this is not reflected in major corresponding savings in staff costs.

2.4.5. DENTAL CARE

2.4.5.1. Introduction

Dental care represents about 10% of the cost of base-level health care at each of the three bases for which we compiled data: Fort Dix, Jacksonville, and March. (See Volume 8.) It consequently represents a significant component of the base health care system, and, if these costs can be reduced, it will be worthwhile.

Beyond concerns for cost, demands on dental officers are growing. The need for dental work on military personnel usually exceeds what is actually accomplished, particularly for recruits. The excess of needs over staff

TABLE 2.4.9

COSTS OF DIRECT-CARE STAFF AT DISPENSARIES
(250 VISITS PER DAY)

		CURRENT		PROPOSED	
	Annual Cost	Number	Annual Cost	Number	Annual Cost
Physicians	14,000	3	$42,000	1	$14,000
Corpsmen E-7	9,000			2	18,000
E-6	8,000	1	8,000		
E-5	6,000	2	12,000	4	24,000
E-4	5,000	2	10,000	1	5,000
Total		8	$72,000	8	$61,000
Corpsmen Training					10,000
					$71,000

Corpsmen training cost = $5000 ÷ 3 years = $1700 per corpsman

capacity has been increased by three recent measures, thus far only partially implemented:

- Inclusion of dental examinations in required physical examinations of non-recruits, with correction of deficiencies.
- Eligibility of dependent children for preventive dentistry programs.
- Provision of routine dental care to retired personnel, under special directives.

In addition, greater familiarity by families of eligible recipients of dental care has led to greater demands than heretofore by dependents on base dental clinics. Even though the policy is to refer dependents needing care to external sources, the maintenance of an open-door policy for dependents (who are in any case eligible for emergency care) increases the load on military dentists.

The increased general demand for dental care beyond the availability of dentists has long been recognized; e.g., by the Survey of Dentistry[1*] and by the American Dental Society. The ADS's Council of Dental Education has been stimulating and cooperating in developing various programs to train dental assistants to work directly with patients, and educate dental students and dentists to use dental assistants effectively. Specifically, the Council was represented in evaluating quality of work in studies of specially trained dental assistants at the Naval Dental Research Institute,[8] Great Lakes, Illinois, and at the U.S. Public Health Service Dental Development Laboratory,[9] Louisville, Kentucky.

Although the long-term outlook is for decreased need on an age-adjusted per capita basis, because of fluoridation programs and possible application of the results of some other current research, near-term demand for dental care, both within and outside the military services, seems likely to increase for many years before it levels off or declines. Currently, preventive dentistry and orthodontic dentistry are sources of increased demand. Ultimately, this work may reduce demand, but only after a lag of many years. Given the demand and the shortage of dentists, there is good reason to explore the use of dental assistants.

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*Numbers refer to references in Section 5.2.7, Dental Assistants.

2.4.5.2. Use of Dental Assistants

Using some sort of assistance is standard, in both military and civilian dentistry. Training for dental technicians in the military services requires between nine and sixteen weeks, and equips the trainee to work under the direct supervision of a dentist. Use of assistants is attractive because it increases the productivity of dentists, reduces the number of dentists staff required for a given level of dental care, and decreases the cost because technicians draw lower wages. Since the cost of training dentists is not usually borne by the services, while the cost of training technicians is, the over-all cost reductions are less than a direct comparison of salaries would suggest.

Although the military services presently use one assistant at each operating chair (usually as a hygienist and general helper) for each dentist, plus a variable number of additional assistants, such as clerks and sterilizer operators, there is considerable evidence that dental assistants can be used still more extensively. In Section 5.2, we reported on several experimental programs in which dental assistants are used in expanded roles. These experiments evaluated the quality of care -- in particular, the quality of restorations placed, shaped, and polished by assistants. The conclusion is that quality is not diminished, and in some cases even improved (though this result could be attributed to the enthusiasm of the special group).

Basing our calculations on these results, we have computed the economic impact of adopting the methods described in these experiments. The conclusion is that dentists engaged in general or restorative dentistry (who comprise about 70% of all the dentists) can operate most efficiently when they use three operatories, each with a chairside assistant, plus one "roving" assistant.

In addition, there is considerable merit in using "circular operatories", (described in Section 5.2) in which the dental chairs are arranged in a fan around a central hub where an assistant is stationed and supplies are kept. This configuration facilitates the dentist moving from patient to patient and supervising the activities of his assistants.

Taking into account all relevant costs (salaries, equipment, construction, and training) the cost per procedure in restorative dentistry can be re-

duced from $4.63 to $3.29 by using three assistants per dentist. It can be reduced still further -- to $2.58 -- by using circular operatories. Furthermore, in the one report described, which mentioned the dentists' reaction, the dentists did not feel that the pace was too hectic. It is true, however, that the costs just mentioned are not based on a large sample and some of the comparisons are open to criticism. Nonetheless, the differences are large enough, and the results plausible enough, to say that the ideas have genuine merit.

2.4.5.3. Recommendations

Our analysis and recommendations for operative and general dentistry are based on review of the results of current experiments and developments in dentistry, and discussions with many dental officers from the Department of Defense and Public Health Service who were familiar with this work, as presented in Section 5.2. Related to results of these experiments are practices in other countries, the relaxing attitudes of some licensing boards (and apparently of the Council on Dental Education) concerning use of properly trained dental technicians, and DOD's need to maintain sufficient capacity in dentistry without recourse to required military service for dentists at a time when there is a national shortage of dentists. All these lead to our conclusion that for a prototype base health care system these experiments provide better guides than does extrapolation of existing conventional practice.

Our recommendations for operative and general dentistry are as follows:

- Dental technicians should be trained for "four-handed" dentistry and for performing specified reversible procedures, under supervision, followed by a dental officer's inspection.
- Dental officers should be oriented to this pattern of care.
- Dental clinics should be designed with multiple operatories in a configuration which facilitates work and supervision as described.
- Dental officers performing restorative dentistry should perform all procedures for which technicians have not been formally trained

and authorized; direct the operations of his team, including performance of authorized restorations and other reversible procedures by technicians who have successfully completed special formal training; and inspect each technician's work.

2.4.5.4. Impact at Military Bases

To put the reduced costs for general and restorative dentistry in another perspective, we have evaluated the impact of the above recommendations at Fort Dix, Jacksonville, and March. This analysis is developed in detail in Section 5.2. The impact on staffing is shown in Table 2.4.10. The impact on costs in shown in Table 2.4.11. The point of view in these tables is that staff can be changed and productivity held constant. Equally tenable, of course, is a view in which dental officers are held constant and productivity increased.

2.4.6. AMBULATORY SERVICES FOR DEPENDENTS AND RETIREES

In Sections 2.4.1. through 2.4.4. we described our recommendations for reorganization of the system for delivery of ambulatory services to active-duty personnel within a dispensary or ambulatory care center setting. This reorganization is in many respects a modification and extension of the system of care currently being provided active-duty personnel in many segments of the military system. We estimated that the use of corpsmen for a greater portion of screening and primary care services will permit a reduction of about 40% in the number of physicians providing these services. It should be recognized, however, that primary ambulatory services for active-duty personnel are a relatively small part of the total medical services provided on a military base; furthermore, in many instances these ambulatory services are currently being delivered quite efficiently. On the average, only about 5% to 20% of the physicians on a base are engaged in providing such services to active-duty personnel.

Most physicians on a typical military base provide ambulatory services to dependents and retirees. In fact, this load is the primary determinant of physician requirements; the inpatient load, in general can be handled by a relatively small increase of staff over that required for the hospital

TABLE 2.4.10

COMPARISON OF STAFFING UNDER PRESENT

AND NEW PATTERNS OF RESTORATIVE DENTISTRY

	Present Pattern	New Pattern
Fort Dix		
Total Dental Officers	58	32
Dental Officers in General or Restorative Dentistry	40	14
Total Other Professional Staff	109	125
Chairside Assistant in General or Restorative Dentistry	40	42
Roving Assistants	0	14
Support Personnel	15	15
Jacksonville		
Total Dental Officers	32	20
Dental Officers in General or Restorative Dentistry	19	7
Total Other Professional Staff	45	54
Chairside Assistant in General or Restorative Dentistry	19	21
Roving Assistants	0	7
Support Personnel	7	7
March		
Total Dental Officers	13	7
Dental Officers in General or Restorative Dentistry	9	3
Total Other Professional Staff	43	46
Chairside Assistant in General or Restorative Dentistry	9	9
Roving Assistants	0	3
Support Personnel	3	3

TABLE 2.4.11

SUMMARY OF SAVINGS AND COSTS ATTRIBUTABLE

TO NEW PATTERNS IN RESTORATIVE DENTISTRY

	Fort Dix	Jacksonville	March
Annual Savings in Operating Expenses	$280,000	$118,000	$69,000
Additional Capital Costs (Space and Equipment)	302,000	129,000	56,000
Annual Savings Including Amortization of Capital Costs	267,000	107,000	64,000

clinics, plus physicians in medical support services, such as anesthesiology, radiology, and pathology. Thus, the reorganization of those ambulatory services which are oriented primarily to dependents and retirees -- namely, the hospital-based clinics -- can have a major effect on the total cost of medical services on the base, and in particular on the requirements for physicians.

In the public sector, there is an increasing awareness that the system of health care delivery must inevitably be reorganized because of the increasing shortage of physicians relative to the growing population and the increasing expectation and need for medical services. Many experiments are currently being carried out under the auspices of medical schools and private and public institutions in the use of paramedical personnel under physician supervision. (See Section 5.1.5.) The Department of Defense pioneered in the use of paramedical personnel, primarily for active-duty personnel; it now has an opportunity to do the same for civilians. We therefore recommend that the general type of reorganization of the health care delivery system described in the previous section for active-duty personnel be extended to the nonactive-duty patients as well.

We recognize that this represents more than a modification and extension of the current system, primarily because there is much less precedent and experience in the nonmilitary sector. We also recognize that it will be more difficult to implement such a reorganization because of problems of acceptance by patients on the one hand, and the reorientation required by physicians and paramedical personnel on the other.

Nevertheless, such a reorganization will not only result in significant savings in the requirements for physicians and in costs, but, as we have pointed out above, is almost inevitable in view of the national trends in physician utilization.

2.4.6.1. Recommendations

As described in Section 5.1.5., much experience has accumulated during the 1960's in the delegation of certain types of services to nonphysicians. There has been a considerable increase in the training and utilization of pediatric nurse practitioners, midwives, and obstetrical nurse practitioners

for prenatal and postnatal care, the use of psychiatric social workers for support in psychotherapy, and the delegation of the care of adults with stabilized chronic illnesses to qualified nurses. The literature suggests that up to 70% of all pediatric services, particularly well-child care and minor illnesses, can be provided adequately by nurse practitioners. The same is true in obstetrics; and at least that percentage of visits for problems related to chronic illnesses such as hypertension and arteriosclerosis heart disease can be managed by nurse practitioners with outcomes equal to or better than those achieved by physicians. Experience would suggest that women, particularly nurses trained at the baccalaureate level, are the best candidates for these types of roles. We therefore recommend the following:

(1) Pediatric nurse practitioners should be trained (if necessary, through individual services' training programs). They should be assigned a specific specialty number designation, so as to restrict their transfer to more general duties. Such qualified nurses should be utilized appropriately to relieve pediatricians of approximately 70% of the current content of ambulatory pediatric practice in the services. Such programs are already underway in both the Army and the Air Force.

(2) Nurse obstetric practitioners should be trained (if necessary, in specific service training programs) to complement the services of obstetric specialists in service hospitals. These nurses should begin by providing prenatal-postnatal care. Following acceptance by physicians and nurses of this degree of change, consideration should be given to staffing some obstetric services with nurse-midwives to handle uncomplicated obstetric deliveries.

(3) We recommend that medical nurse practitioners concerned with the management of patients (retirees and dependents) suffering from chronic diseases be trained, if necessary within service-initiated schools. They should assume responsibility for 70% to 80% of all services required by those individuals who are in a relatively stable phase of the natural history of a chronic disease.

The above represent the areas where physicians' substitutes have been utilized to the greatest extent in the nonmilitary sector, and have therefore been suggested for initial implementation. In addition, physician substitutes can be used to advantage in such areas as general therapy and the orthopedic, surgical, and urologic clinics. In many respects, these services represent areas similar to those in which corpsmen are already being used extensively for military personnel; specialty training programs for orthopedic and surgical corpsmen already exist. Subsequent implementation in these areas, therefore, should not pose excessive problems.

2.4.6.2. Impact of Reorganization of Ambulatory Services for Dependents

2.4.6.2.1 Reduction in Physicians

To estimate the potential impact of reorganizing the system of ambulatory services to dependents and retirees, we have reviewed the hospital-based clinics at each of the three hospitals that we have studied intensively: March Air Force Base Hospital, Jacksonville Naval Hospital, and Walson Army Hospital (Fort Dix).

March Air Force Base Hospital. Table 2.4.12 shows the proposed versus current physician assignments to clinics at March AFB Hospital. We have assumed that the total number of physicians and physician substitutes (corpsmen, nurse practitioners, physician assistants) will remain the same as the current number of MD's. Reorganization would have greatest impact in the general therapy, pediatric, psychiatric, orthopedic, and surgical clinics. A few examples will indicate our approach.

The general therapy clinic, for example, has an average of about 150 patient visits per day, divided approximately into 25% active-duty personnel, 35% dependents, and 40% retirees. We estimate that 70% of the active-duty visits, 50% of the dependent visits, and 33% of the retiree visits could be handled by nonphysicians. Thus, of a total of 150 visits, only about half would require a physician. We estimate that the total load could be handled by three physicians and three properly trained physician's assistants/corpsmen instead of the six physicians currently assigned.

TABLE 2.4.12

EXAMPLE OF REORGANIZATION OF

AMBULATORY SERVICES

MARCH AFB HOSPITAL

Clinic	Average Visits Per Day[a]	Staffing		
		Current MD's[b]	Proposed MD	Proposed MD Substitutes
General Therapy	150	6	3	3
Emergency Room	95	1	1	
Surgical	40	6	3	3
Orthopedics	50	4	2	2
Ear, Nose and Throat	25	2	1	1
Ophthalmology	15	2	1	1
Urology	45	3	2	1
Obstetric and Gynecology	85	5	3	2
Internal Medicine	25	4	3	1
Pediatrics	100	4	2	2
Neurology	7	1	1	
Allergy	85	1	1	
Dermatology	35	2	1	1
Psychiatric	20	4	2	2
Subtotal		45	26	19
Support		6	6	
Administration		2	2	—
TOTAL		53	34	19

a. Based on "Clinical Data for March AFB", 5-month totals
b. Major B. F. Bauman, private communication, April 1970

Similarly, an analysis of pediatric ambulatory care typically indicates that approximately 60% to 70% of the patient load consists of routine or well-baby care. As indicated in a variety of studies, this care could be provided adequately by physician substitutes (pediatric nurse practitioners) with appropriate education and training. This would reduce to about 30 visits per day, out of a total 100 visits per day, the number of pediatric patients who need to be seen by a physician. Considering the relatively small pediatric inpatient service (10 cribs and 5 beds, plus a 30-crib nursery), we believe that two pediatricians with adequate support from two physician substitutes could maintain the present level of service.

An analysis of the requirements for psychiatric services is somewhat difficult to make without a detailed review. The available statistics (12 psychiatric beds and a load of 20 outpatient visits per day) suggests that two psychiatrists, practicing under standards prevalent in civilian psychiatric services, should be able to carry this workload. The remainder of the load can be handled by two psychiatric social workers. More detailed analysis of local needs, such as the number of consultations or possible involvements of psychiatry in other hospital services, might indicate a reduction to one psychiatrist or an increase to three.

It should also be possible to reduce the number of physicians in orthopedic and urologic services, provided they were replaced by adequately prepared orthopedic and urologic technicians. The number of urologic beds and outpatients (approximately 20 to 25 beds in the hospital occupied by urologic patients, and an average of 20 patients per day are seen) indicates that two urologists, performing the surgery and most technical diagnostic procedures (cystoscopy, intravenous retrograde pyelograms, etc.), should be able to provide both the diagnostic and therapeutic services if supported by two appropriately trained surgical technicians.

The obstetric service performs approximately 140 deliveries per year, in addition to gynecological procedures and approximately 15 to 18 obstetric and gynecological patient visits per day per physician. This would approximate a moderately active practice in the civilian medical care system. The introduction of obstetrical nurse practitioners for

prenatal and postnatal care would permit a reduction in the number of OB/GYN physicians of about 40%.

Table 2.4.12 indicates that it should be possible to replace approximately 19 physicians, or about 40% of those assigned to clinics at March AFB Hospital, with appropriately trained and experienced physician substitutes. A more detailed analysis of individual clinic requirements might indicate minor adjustments in the staffing of an individual clinic, but we are confident that this represents the order of magnitude of the potential savings.

Jacksonville Naval Hospital. Table 2.4.13 shows physician staffing at the Jacksonville Hospital as of 1 August 1969. There are 76 physicians, including 9 physicians in medical support activities (radiology, anesthesiology, and pathology) and 19 interns and residents. We estimate that about 40% of the physicians assigned to the general practice, emergency room, medicine, ENT, pediatrics, and surgery clinics can be replaced by suitably trained and supervised physician substitutes. We assume that the number of physicians in support services will remain the same, and that other supporting staff will also be unchanged.

Walson Army Hospital. Table 2.4.14 compares current with proposed staff assignments of physicians to clinics at Walson Army Hospital, Fort Dix. The medical, pediatric and general outpatient clinics would be most affected. In these clinics we estimate that corpsmen can handle about half the total workload.

The table indicates that the Walson Army Hospital outpatient clinics can be operated under the proposed system with approximately 46 physicians and 32 substitute physicians; this compares with a current staffing of about 78-1/2 physicians. We thus project a reduction of 40% in the number of physicians required. In summary, we estimate that the present effective strength of 101 physicians (including 6 residents) assigned to ambulatory and inpatient services at the hospital can be replaced under our reorganization with 68 physicians and 32 corpsmen.

2.4.6.2.2. Cost Savings

Table 2.4.15 summaries the impact of physician substitution on ambulatory care for dependents and retirees. About 40% of physicians providing

TABLE 2.4.13

PHYSICIAN STAFFING OF CLINICS--JACKSONVILLE NAVAL HOSPITAL

Clinic	Visits FY 1969[a]	Visits Per Day	Staffing		
			Current MD's[b]	Proposed MD	MD Substitutes
General Practice	40,700	155	7	3	4
Emergency Room	24,301	65			
Allergy	1,600	6			
Neuropsychiatric	15,200	60	4	4	
Urology	10,000	40	2	2	
Eye (Except Optometry)	6,750	30	2	1	1
Ear, Nose and Throat	7,700	30	3	2	1
Medicine	11,200	45	7	4	3
Dermatology	9,000	35	2	1	1
Surgery	8,600	35	5	3	2
Obstetrics and Gynecology	38,000	145	5	3	2
Pediatrics	28,000	110	7	3	4
Orthopedics	7,800	30	3	2	1
			47	28	19
Interns and Residents			19	19	
			66	47	19
Support			9	9	
Administration			1	1	
TOTAL			76	57	19

a. Workload statistics, FY 1969
b. Naval Hospital, Jacksonville, Florida, Directory of Officers, August 1969

TABLE 2.4.14

PHYSICIAN STAFFING OF CLINICS--WALSON ARMY HOSPITAL

Clinic	Average Visits Per Day	Staffing		
		Current	Proposed	
		MD's[a]	MD	MD Substitutes
Medical				
Gastrointestinal	120	11-1/2	7-1/2	4
Cardiology				
Pediatrics	200	11	5	6
Dermatology	25	1	1	
Allergy	45	1	1	
Neuropsychiatry	110	6	5	1
Neurology	40	2	2	
Surgical	60	10	5	5
Orthopedics & Physical Therapy	160	8-1/2	5	3-1/2
Genitourinary	30	4	2	2
Ear, Nose and Throat	50	2	2	
Eye	35	2	1	1
Obstetrics and Gynecology	115	6	4	2
General Outpatient (including Emergency Room)	400	13-1/2	5-1/2	8
		78-1/2	46	32-1/2
Wards		9	9	
Support		11-1/2	11-1/2	
Administration		2	2	
		101	68-1/2	32-1/2
Other (including dispensaries)		12	12	
TOTAL		113	80-1/2	32-1/2

a. Including residents. From "USA Medical Department Activities, Fort Dix, N. J., 1 April 1970"

TABLE 2.4.15

PHYSICIAN SUBSTITUTION IN AMBULATORY CARE

Hospital	Total MD's	Clinics	Other	Support Services	Visits Per Year	MD's Substituted	Estimated Annual Staff Savings
March	53	45	2	6	225,000	19	$114,000
Jacksonville	76	47	20	9	225,000	19	114,000
Walson	113	78-1/2	23	11-1/2	425,000	32-1/2	195,000
Total	242	170-1/2	45	26-1/2	875,000	70-1/2	$423,000

ambulatory care in the clinics at the three hospitals can be replaced by appropriately trained nurse practitioners, corpsmen, or other physician substitutes. The high-volume clinics -- pediatrics, surgery, orthopedics, and general therapy -- are the ones primarily affected. Assuming that the average annual salary of a physician (with the equivalent rank of Major) is $15,000 and that the physician is replaced with a registered nurse or coprsman trained at the level of the independent-duty corpsman (E-7 level) at an annual salary level of $9000, the potential saving in staff cost is $6000 per physician substituted. This amounts to about $425,000 annually at the three hospitals. These savings will become moreimportant as the ratio of physician/substitute physician costs increases. This rough computation needs to be modified for other physician substitutes--we have used $10,000 as a typical nurse's salary, which means that substituting a nurse practitioner for a physician would reduce costs by $5000 annually.

2.4.7. ANALYSIS OF BENEFITS AND COSTS

This section summarizes the estimated benefits and potential disadvantages of our recommendations for reorganization of ambulatory services.

2.4.7.1. Benefits

2.4.7.1.1. Medical Care System

We are convinced that the proposed system represents the direction in which national medical care must move. The Department of Defense has an opportunity to lead the way and to provide a model for a national health care system, as well as to gain experience for providing a similar system for nonactive-duty patients.

2.4.7.1.2. Hospital Visits

The number of visits to hospital-based clinics and diagnostic services by active-duty personnel will be sharply reduced through the proposed reorganization and enhancement of dispensary capabilities. We estimate that the number of active-duty visits to the hospital will be cut from about

20% of patients to 10%. This reduction is partially due to installation of X-ray facilities, which will handle 90% of X-ray requirements, and increased treatment services (primarily orthopedic and minor surgical). Thus, at a dispensary with 250 visits per day, about 25 fewer patients per day will have to go to the hospital. At Fort Dix, this would represent about 25,000 fewer visits per year to the hospital. The following benefits are obtained:

(1) Less time is lost by patients traveling to the hospital and waiting for service. At Fort Dix, for example, sick call patients may take a bus from the dispensary to the hospital. The bus begins picking up personnel at 10 a.m. and completes deliveries at 11 a.m. At the hospital, the patient must wait for his procedure and then return to barracks or the dispensary. Each patient would save at least two hours by the reorganization.

(2) A major problem is that patients are under less control when in the hospital: it is not unusual for a patient to make a full-day junket of the hospital visit. In the care center environment, which is oriented to the patient's brigade, there is greater control and surveillance of the patient.

(3) Hospital staff will be less occupied with patients who are only moderately ill or have comparatively simple diagnostic requirements, and will be able to concentrate on the more complex and difficult patients, which should be its major responsibility.

2.4.7.1.3. Physician Requirements

In Sections 2.4.4. and 2.4.6. we estimated that about 40% of the present physicians can be replaced by appropriately trained corpsmen, nurse practitioners, or other physician substitutes. The potential number of physicians that can be substituted in the three hospitals that we have studied intensively (Walson, Jacksonville, and March) is about 80 physicians. If this is done, about $423,000 in annual staff costs could be saved at these hospitals. These staff savings will increase if the salary difference between physicians and nonphysicians widens.

2.4.7.1.4. Field Unit Experience

The ambulatory care center approximates more closely the dispensary service for troops in theaters of operations. Thus, the staff -- both corpsmen and physicians -- will gain experience which is more relevant to field conditions. In particular, physicians will gain command and supervisory experience, and corpsmen will gain experience in acting more independently, while still under supervision and with physician backup.

2.4.7.1.5. Relations to Operational Units

The care centers will be oriented to the operational units (brigades) which they are serving. This will provide opportunities for the dispensary physicians to more fully understand brigade medical problems and to institute preventive medicine and mental hygiene procedures with the brigade commanders.

Patients will receive greater continuity of care, since the corpsmen will be responsible for providing care to a given brigade and will become familiar with the patients in the brigade; and a greater part of the total care will be provided in one location rather than in several locations and by several physicians.

2.4.7.1.6. Operating Efficiency

The ambulatory care center, as we recommend it be organized and operated, is a highly specialized health facility, serving a relatively homogeneous population (active-duty military personnel) and treating a limited number of presenting diagnoses. It thus facilitates the efficient utilization of less highly trained personnel. For this reason, a given procedure (examination, treatment, or test) can probably be done more economically in the ambulatory care center than in the hospital clinic environment, which handled more complex cases and a much larger diversity of patients and treatments. For example, it has been estimated that the cost per dispensary visit (at Fort Benning in 1967) was $2.19 versus $5.10 in the outpatient clinic, based on the salaries of the personnel involved.* It is obviously difficult to

*"An Evaluation of the Efficiency and Effectiveness of the Sick Call System and Facilities at Fort Benning, Georgia," Robert A. Hille, LTC MSC (1967).

evaluate the exact difference in cost, because of the necessity to control a large number of factors including type of patient, type of presenting symptoms, treatments, and dispositions; this would require a detailed prospective experiment. In addition, a careful analysis would have to be made of overhead costs, such as for administration, maintenance, records, and scheduling.

2.4.7.1.7. Staff Satisfaction

Both physicians and corpsmen will have greater professional satisfaction under the proposed reorganization. Physicians will be relieved of routine primary care and screening, which call upon little of their training. Instead, they will be acting as supervisors and preceptors, and in general be responsible for a wider range of medical care in a consultant and supervisory capacity. This will be more attractive to physicians who are interested in the provision of primary care.

Corpsmen will be able to undertake enhanced responsibility and consequently will have more opportunity for advancement within the medical care structure. One of the chief complaints of the corpsmen -- namely, that their experience and training is under-utilized in the continental U.S. -- will disappear. The greater satisfaction on the part of the corpsmen, and the greater opportunities for advancement within the defense medical structure, should help reduce the rate of retirements from the service.*

2.4.7.1.8. Use of Ancillary Services, Referrals, and Hospitalization

As we have indicated earlier, there is evidence that greater use of corpsmen will result in reduction in use of ancillary services such as X-ray and lab tests without impairing the quality of care, and that this reduction could be at least 25%. Specialty referrals and hospital admissions should also decrease. Balancing this is the possibility that revisits may be more frequent. Although these effects can be rationalized, none of them can be considered proven, because of the difficulty in con-

*"Manning the Future Navy," Annex A, CNA Institute of Naval Studies, Study II (1964).

trolling the situations in which the measurements and comparisons were made. For the current analysis we have therefore conservatively assumed that these effects will balance out. We recommend, however, that carefully controlled measurements be made of these effects, preferably in connection with the prototype ambulatory center.

2.4.7.2. Potential Disadvantages

2.4.7.2.1. Quality of Care

It may be argued that quality of care is impaired when fewer patients are seen by physicians, since a highly-trained physician is more likely to recognize a serious problem than is a corpsman. The dispensary physicians with whom we have talked believe, however, that this is not necessarily so, since they become bored working within the dispensary environment, seeing a large number of routine diseases, and in many instances only providing certifications. Also, corpsmen become very adept at treating certain illnesses, particularly if they specialize in a given area such as orthopedics. Although our data show no evidence that quality of care is impaired when corpsmen assume greater responsibilities for disposition of patients, the numbers are too small either to prove or disprove this hypothesis.

As discussed in Section 5.1.5., there have been a few studies in the nonmilitary sector of the effect of physician substitution on quality care. These indicate that quality care is not impaired.

2.4.7.2.2. Repeat Visits

There is some evidence that repeat visits increase when corpsmen provide primary screening, although this is confounded by the difference in type of patient being seen and the differences in referral patterns. It also appears that more repeat visits may be balanced by fewer referrals and less use of diagnostic facilities per visit (Section 5.1.1.). A recent experiment at Fort Ord suggested, in fact, that the total number of visits is less when corpsmen do the screening than when physicians do, over a period of time, perhaps because continuity of care was

greater when corpsmen did the screening. Thus, this aspect is also undecided; we assume that the effects balance.

2.4.7.2.3. Cost for Training

A cost is involved in setting up and running programs for training corpsmen in their new duties (Section 2.2.). Some of the training programs already exist; the training of independent-duty Navy corpsmen is particularly relevant. The major additional requirement is on-the-job training. Several new training programs for the medical specialist corpsmen will have to be set up.

We have not made detailed estimates of the training program costs, but we assume them to be about $5000 per corpsmen, and that they will be "amortized" over three years on the average.

2.4.7.2.4. Capital Costs

Additional capital costs may be involved in the additional facilities of the ambulatory care center. The prototype care center (Figure 2.4.8) is approximately twice the size of two current smaller centers (each of which serves half the recommended population), so no additional costs should be involved in the building itself. The X-ray unit (capital cost $50,000) may be partially redundant if the equivalent unit cannot be eliminated in the hospital; therefore, we estimate that additional capital costs to be about $25,000 per center.

2.4.7.2.5. Patient Dissatisfaction

Patients may be less satisfied when they are seen by a corpsmen instead of a physician, even though a physician is available as backup and for consultation. Our observations, both in the military and non-military sectors, would indicate, however, that any initial reluctance usually disappears after patients become accustomed to the physician substitute (assuming that he has the suitable personal and professional qualifications) and realize that a physician is in attendance and maintains close supervision and review.

2.4.7.2.6. Legal Implications

The legal implications of using nonphysicians in roles traditionally reserved for physicians raises genuine legal and ethical problems. Generally speaking, physicians are accustomed to taking full responsibility for the welfare of each of their patients, and the laws of the states codify this responsibility. There is a tendency, made evident by the frequency of malpractice suits, the size of awards, and the cost of insurance, to hold physicians rigorously to their responsibilities. This state of affairs strongly reinforces physicians' reluctance to delegate responsibilities to nonphysicians whose work is not directly and continually supervised.

On the other hand, the activities and roles we have described for nonphysicians are being tried experimentally in numerous civilian practices, and programs generally consistent with what we have outlined have been undertaken in a variety of settings, including very recently the military services. Thus potential roles for nonphysicians are being actively and seriously explored, and, while legal problems remain, state laws will gradually adapt to these new concepts. California, for example, recently passed legislation specifically aimed at facilitating the use of physician assistants.

In a report of the Board on Medicine of the National Academy of Sciences (Reference 23 in Section 5.1) there are defined three categories of physicians' assistants:

- Type A assistants usually though not always work under surveillance by a physician and are trained to collect medical histories and physical data, to organize these data, and to present them in a way that the physician can visualize the medical problem and determine appropriate diagnostic or therapeutic steps; they also may perform some diagnostic or therapeutic procedures.
- Type B assistants possess exceptional skill in one specialty (e.g., renal dialysis).
- Type C assistants work under supervision of a physician and are trained in general medicine though they do not possess the level of knowledge necessary to integrate and interpret findings.

Types B and C have long been on the scene; Type A is new in civilian practice and in domestic military practice. The report cites the exploratory nature of concepts utilizing Type A assistants especially but urges that states refrain from codifying circumstances under which Type A assistants can practice until more experience has accumulated. Though there are many countervailing opinions, the trend of the times is to explore possibilities with physician assistants, and laws and codes will generally follow.

The situation for the military services is different in some respects. Military personnel generally do not claim malpractice, though legally speaking they could. However, there is not much precedent for this issue. Most states have exempted physicians who are commissioned officers from local licensing requirements. In the case of corpsmen, the situation is less clear, although so far the issue has never been raised. The states generally have been willing to leave these matters purely within the military, and local state medical societies have shown no inclination to raise the issue.

Dependents, on the other hand, can sue if they feel malpractice has been committed, though the volume of such suits is small. It is possible that when corpsmen assume greater responsibility for treating dependents, local medical societies and state licensing boards may raise the issue. On the other hand, the nation as a whole must inevitably face the issue of physicians' assistants -- and arrive at an accommodation.

2.5. HOSPITAL SERVICES

2.5.1. INTRODUCTION

The major impact of technology on military health care is in the area of hospital services -- matters indirectly related to patient care, including practices in laboratory, radiology, pharmacy, food service, linen service, materials handling, and information handling. For these functions, modern technology offers some novel alternatives, some of which can provide significant benefits to military hospitals.

The conclusions presented in this section are based on analyses that are presented in the appendices; the latter are cited wherever applicable. As will be seen in Section 2.6, the savings available from new technology are never large and in some cases are nonexistent. However, there are other benefits, such as reduction of errors and improvement of quality, which can also serve as justifications. We shall repeat in this section the essential arguments which led to our conclusions, but we will omit most of the details.

In this chapter on hospital services we will deal first with five hypotheses, all of which yielded essentially negative conclusions: either the hypothesized innovation did not yield a savings or improvement in care, or the improvement was considered to be slight. These five matters concern automated materials handling, disposable linens, optimum room size, more efficient use of nursing personnel, and elimination of obstetrical services.

The next six hypotheses deal mainly with computer applications -- for communications, patient monitoring, multiphasic testing, automatic dispensing of drugs, laboratory automation, and certain other uses such as assistance in diagnosis, history-taking, and scheduling. Computer applications in hospitals for purposes other than accounting present something of a dilemma. In general they have fallen short of their promise, though there are some notable exceptions. Many applications must be considered experimental, and their benefits are difficult to predict. Despite current problems, we expect that many applications about which hospital personnel are now skeptical will become accepted in practice and reasonable in cost in the next five to seven years. Therefore, we believe that DOD should

undertake evaluation of some applications in the prototype hospital, that it should develop others, and that it should periodically review applications about which we have reached negative conclusions.

The last subject discussed is convenience food service. Here the evidence is unequivocal: convenience foods are cheaper to buy and serve than foods prepared the conventional way, they do not require a kitchen in the hospital, and they offer desirable flexibility with regard to the times and places at which meals are served

2.5.2. AUTOMATED MATERIALS HANDLING

In normal operation, all hospitals require the transfer of large amounts of materials (such as linen, meals, equipment, and trash) and large numbers of smaller items (such as drugs, supplies, prescriptions, and other paperwork). The costs associated with moving materials are significant, though they are not large compared with total operating budgets. (Manual cart delivery systems, such as those now used at most military hospitals, incur annual costs of $153,000 at Walson Army Hospital, $112,700 at Jacksonville, and $95,000 at March AFB.) These figures and others used subsequently were developed in Section 7.1.

Dozens of systems for moving materials in hospitals are now available in the United States. For convenience, these systems can be grouped by type; within any one group, the kinds of materials which can be handled and the costs of installation and operation are generally comparable. The generic systems we considered were the following:

- Manual systems, in which carts are moved by hand from place to place in the hospital, using elevators for vertical travel.
- Automatic module systems, typified by Cyberail, Amscar, or ACTS (Automatic Cart Transport System), in which a module large enough for most bulk items moves automatically to its destination.
- Semiautomatic module systems, in which vertical delivery uses a dedicated elevator and is fully automatic, and horizontal movement is manual.

- Tote box systems, in which boxes with a capacity of 1 or 2 cubic feet move automatically on conveyor belts and chain lifts to the destination coded on the box.
- Telelift, a unique system, in which boxes with a capacity of 1 or 2 cubic feet move automatically on a monorail, both vertically and horizontally, to a destination coded on the box.
- Pneumatic tube systems, in which containers (usually cylindrical and large enough for papers, drugs, or specimens) are blown or sucked through pipes to the destination encoded on them.
- Vacuum collection systems, in which trash and soiled linen are collected through chutes and a horizontal high-capacity vacuum collection system.
- Trayveyor systems, designed primarily for food service, in which trays are moved horizontally on conveyor belts and vertically on chain lifts.

Although several new concepts for drive mechanisms are currently under development, dramatically new developments in materials handling are unlikely in the next five or ten years. The systems presently available seem to span the range of conceivable alternatives.

Our approach to evaluation of existing systems is based mainly upon costs. However, the following attributes also have a bearing on selection:

- Flexibility
- Reliability
- Adaptability to building spaces
- Suitability as retrofits
- Consonance with the hospital environment.

These characteristics had a tempering influence on our choices.

We derived annual operating costs for systems in each of the three hospitals under study, using their present materials handling load as the basic requirement. Costs include salaries for personnel, amortization of the capital investment, and operating expenses (power and maintenance). Each system was compared with a manual cart-exchange system for the following bulk items:

- Clean and soiled linen
- Meals and soiled trays
- Drugs
- General supplies
- Medical supplies
- Sterile trays and soiled utensils
- Trash

Most systems are useful for only a portion of the above items (for examp'es, Telelift is too small for linens or trash; Cyberail is too large to be efficient for miscellaneous deliveries of drugs); therefore, a residual portion of the load was assigned to a manual system for making comparisons.

Costs to install and operate the systems were solicited from manufacturers. While these costs do not appear unrealistic to us, we believe that they should be regarded as lower limits. Comparative annual operating and amortization costs are given in Table 2.5.1.

TABLE 2.5.1

COMPARATIVE OPERATING AND AMORTIZATION COSTS
FOR MATERIALS HANDLING SYSTEMS

	Fort Dix	Jacksonville	March AFB
Manual	$153,000	$112,700	$ 95,300
Automatic Module	210,000	155,200	102,000
Semiautomatic Module	163,400	121,550	96,300
Tote Box	185,000	122,300	110,300
Telelift	174,700	118,000	104,700
Pneumatic Tube	180,400	132,000	112,200
Vacuum Collection*	150,800	110,700	93,700
Trayveyor	145,250	101,050	87,600

*This does not include cost of disposal beyond the collection point.

On the basis of cost, one is led to discard all systems as alternatives to a manual system except vacuum collection systems and Trayveyor-like systems for food trays. Note that paperwork has been excluded from this analysis; had it been included, tote box systems, Telelift, and

pneumatic tube systems would appear in a more favorable light. However, we have analyzed the cost of moving paperwork in Section 7.5 (Hospital Communications) and have concluded that manual transport is generally cheaper, Even if this were not so, we believe that investment in mechanical means for moving paper is unwarranted, because a substantial part of the paperwork will shortly be taken over by computer-based communication systems.

While the annual operating costs of some of the nonmanual systems are not a great deal larger than those of the manual system, we believe that the manual system is preferable on other grounds as well:

- It is completely flexible and can adapt at low cost to changes in the building layout or new classes of materials.
- It is reliable and requires little maintenance. (Achieving a good standard of maintenance is a perennial problem in military hospitals because of rapid turnover of staff.)
- It can be made fully consonant with hospital standards of quietness, attractiveness, safety, and cleanliness.
- Labor costs are minimal; in fact, if convalescent patients can be utilized, most of the labor is free.

In developing costs for all materiel classes except trash, we have assumed a manual system with cart exchange; that is, the cart is used for storage of fresh items after delivery and for collection of soiled items after use. There are significant advantages to cart exchange, including reduction of storage space required, reduction of rehandling, and, in the case of drugs, the chance to enlist the pharmacist in a central role for reviewing and administration of medications.

Vacuum collection systems for trash and soiled linen offer modest attractions in terms of reduced costs. Since some free labor is available from convalescing patients, we may have overstated the costs of the manual alternative; on the other hand, in many military hospitals, trash collection is done by housekeeping contractors for whom costs have been stated realistically. Furthermore, there is every reason to believe that the amount of trash generated will increase in coming years because of more extensive use of disposables. On balance, we have concluded that vacuum collection systems are desirable.

Trayveyor-like systems for delivery of meal trays lend themselves to convenience foods if the hospital can be configured to place the food assembly area directly beneath the nursing wards. We are not sanguine, however, about the maintenance problem alluded to above nor about flexibility if building layout should be changed. Accordingly, we are inclined toward the belief that manual delivery with a cart exchange system would be preferable.

2.5.3. DISPOSABLE LINENS

Disposable linens for hospitals have received wide attention as an alternative to conventional linens. In Section 7.4 we have summarized the advantages and disadvantages of each and concluded that, with a few exceptions, disposable linens are both more costly and less satisfactory than reusable ones. The arguments can be summarized as follows:

- Disposable linens, including bedsheets, pillowcases, washcloths, patient gowns, lab coats, service dress, surgeons' gowns, scrub shirts, and scrub pants cost from two to three times as much as reusables when the costs of replacement, laundering, ironing, and sterilization are included; the major exception is diapers, both kinds of which cost about the same.

- The costs of disposables are unlikely to decrease; future developments are expected to concentrate on improving quality rather than reducing costs.

- In general, disposables are inferior to launderable linens with regard to feel, drape, strength, porosity, and absorbency.

- There is some additional convenience to using disposables, especially items which become heavily soiled such as diapers, but this convenience is not readily equated with tangible benefits such as staff reductions.

- Disposables may reduce problems with contamination or poor sterilization, but there is no convincing evidence that equal infection control cannot be maintained with reusable items.

On balance, we have concluded that, with the exception of diapers and some surgical packs, durable linens are currently preferable to disposables. However, this picture may change, and it therefore seems prudent not to make a positive commitment to reusables by building a laundry into a new hospital. Other alternatives are to use the base laundry, as is done on most military bases; to use a commercial laundering service; or to rent clean linens from a linen supply service.

One cannot generalize about the relative merits of these alternatives -- each may be attractive, depending on the local situation. In principle, a base laundry should be cheaper, since it need not return a profit, but inefficiency can make it actually more expensive than an outside service.

The use of disposables in general -- not only linens, but also syringes, bed pans, urinals, basins, and a variety of instruments and implements -- has been growing in civilian hospitals at an astounding rate, presumably because of rising labor rates and difficulties with quality control of sterilization. In this area, DOD hospitals can afford to follow their civilian counterparts, making use of disposable items as they become attractive from the standpoint of cost or convenience.

Right now, the trend is clear, but it could be reversed by concerns over pollution. Greater use of disposables increases the load on the trash collection system, which is another reason for finding vacuum collection systems attractive.

2.5.4. OPTIMUM ROOM SIZE

One might imagine that there is an economically optimum number of beds for patient rooms. Large rooms offer the economies of eliminating dividing walls, easier access to patients, and easier upkeep and cleaning. Small rooms offer the economy of reducing problems with mixing patients (e.g., men with women, very ill patients with convalescing patients, officers

with enlisted men, etc.). On the strength of the latter point, plus a belief that patients prefer privacy, most hospitals under construction today in the United States have nothing but private rooms.

Strictly from an economic standpoint, there should be a room size which minimizes the total cost of providing rooms to a given mix of patients. In Section 6.3 we have explored this possibility parametrically, that is, without relating the numbers to any real hospital. We concluded from this analysis that whatever economies large rooms do offer are realized when eight or ten beds are put in one room, so there is no economic incentive for making still larger wards.

At the small end of the scale, other considerations besides economics dominate. Some patients desire private rooms, while others (particularly young men) prefer to have the company of other patients. Nurses have varying views, although most feel that multiple-bed rooms are more convenient.

One interesting point is that three-bed rooms are undesirable, because two patients often "gang up" on a third. In two-bed rooms, patients either become friendly or not, but neither must bear the unpleasantness of being excluded by a consensus. In four-bed rooms, patients typically form two two-person partnerships.

We conclude that there is no unique answer to the question of room size. Hospitals should be designed with a mix of room sizes -- a 24-bed ward, for example, might include eight singles, four doubles, and two four-bed rooms.

2.5.5. NURSING SERVICES

The major recommended changes in nursing services are (1) elimination of some positions by introducing light care facilities and (2) providing some assistance to the nursing staff through the use of computers in clinical care. By and large, we found the standard of nursing and the caliber of nursing staff in military hospitals to be very high. Nevertheless, there are some changes which may produce modest reductions in cost or modest improvements in quality of care.

We believe that there are advantages to using ward clerks to relieve

nurses of many clerical tasks, at least until computer systems are effective in this role. Similarly, there are advantages to using unit managers (wardmasters) for similar purposes, e.g., providing non-nursing services to patients; managing admissions, transfers, and discharges; and managing housekeeping details, supplies, and requisitions.

Variations in the need for nursing staff as the patient census changes is a perennial problem in all hospitals. A rational approach to this problem involves classifying patients according to the amount of nursing care they require and reassigning nurses in a manner which reflects needs but is also responsive to nurses' qualifications, obligations, and personal preferences. To increase flexibility it is well to identify some nurses as "floaters", that is, nurses who can be reassigned as needed. Not all nurses like this role, but some do, and the scheme has been found advantageous in some hospitals. Additional flexibility can be gained by using "on-call" nurses, who serve as needed on a part-time basis. Usual civil service procedures stand in the way of this scheme, but, given the fluctuations in patient census, the idea has merit. In Section 7.7. and later in this volume, we describe a computer-assisted method for nurse scheduling.

2.5.6. ELIMINATION OF OBSTETRICAL SERVICES

One conceivable avenue to reducing the costs of providing health care to military personnel, their dependents, and retirees is to eliminate certain services, providing them instead through CHAMPUS. Because obstetrical services serve no direct military need and because they usually form an isolatable service, both organizationally and physically, they are natural candidates for elimination.

After analyzing all relevant costs -- physicians and nursing staff, maintenance and utility costs, lab tests, facility amortization, supplies, linens, food and overhead -- we found that the cost per delivery (including prenatal care) at Walson Army Hospital is $330, at Jacksonville Naval Hospital, $322, and at March AFB, $392. Costs for equivalent services under CHAMPUS are about $500 per delivery, of which the patient pays $25, making the cost to DOD about $475. Thus, CHAMPUS costs are generally higher.

However, when the population cared for is so small that the number of births drops below about 500 per year, CHAMPUS becomes a cheaper alternative. To some extent, DOD can take advantage of this fact by not providing obstetrical services in its smaller hospitals, if adequate civilian obstetrical services are available in the area. This view is, of course, weakened by the fact that under present draft laws DOD obtains the services of many obstetricians and gynecologists for whom it has an obligation to provide appropriate professional experience. Furthermore, since the missions of military bases sometimes change, the patient population can change suddenly, and the number of births can change as well. As a general conclusion, therefore, elimination of obstetrical services from military hospitals is not usually warranted.

Using this result as a guideline, we believe that the total cost of health care for the military population is unlikely to be reduced by dropping services from military hospitals.

2.5.7. COMPUTER-BASED COMMUNICATIONS

In this and the succeeding five sections we consider applications of computers for various aspects of clinical practice. Some of these applications are well developed, and we can be quite definitive about their merits or deficiencies; others are still experimental. Computer-based communications fall into the latter category and are reviewed at greater length in Section 7.5.

Computer systems which embrace ordering and result reporting, inpatients' working charts, nursing notes, physicians' reports, patient logistics, and scheduling are called hospital information systems or medical information systems. Many suppliers have attempted to develop such systems. The first to reach pilot operational status was National Data Communication's REACH (Real-time Electronic Access Communications for Hospitals), but others are now offered by Lockheed, Spectra, Medelco, Meditech, Compucare, Control Data, General Electric, IBM, McDonnell Automation, Medi-Data, and Sanders Associates. These are described in more detail in Section 7.5.

On the basis of experience so far, it is not possible to justify the

cost of these systems or to be certain that the benefits they promise will be realized. Nevertheless, we can see no essential barriers to their ultimate success, and we believe that DOD should participate in their development. This should be regarded as an experimental program aimed at obtaining data for cost-benefit analysis and adapting such systems to the special conditions in military hospitals. (For example, accumulating costs for individual patients receives a great deal of attention in civilian hospital information systems but is wholly irrelevant in military hospitals.)

With this in mind, we recommend installation of a computer-based communication system in the prototype hospital. It should embrace the following functions:

- Recording data on admissions and patient transfers and maintaining a bed census;

- Recording and forwarding to the laboratory all test requests, and generating specimen collection schedules and lab work plans;

- Recording lab results, either automatically from automatic equipment or manually from nonautomated equipment (excluding, of course, those performed on fast analyzers, as discussed in Section 7.6) and maintaining cumulative records of results for a week;

- Recording and forwarding to the pharmacy all inpatient prescriptions, printing labels, and other data for drug deliveries from the pharmacy, and providing drug administration worksheets for nurses;

- Recording requests and scheduling appointments in radiology and accepting results, including free text recorded and entered by a stenographer;

- Recording all nursing orders from physicians and providing a care plan for each inpatient;

- Issuing reminders to nurses, lab personnel, etc., for work not completed and recorded after specified intervals, and reminders of medications or other actions due;

- Recording schedules for outpatient visits to clinics and generating appointment schedules for each physician in the clinic;

- Generating a shift summary of nursing notes for nurses' signatures and a 24-hour summary of nursing notes for each inpatient;

- Logging dispatch and receipt of record folders and X-rays, using an optical or magnetic reader of special labels on each such folder; and

- Generating a discharge summary from internal records at time of patient discharge.

Although a total information system is conceivable, we believe that DOD should not try at this stage to include all computer applications in a single system. Succeeding sections describe additional applications to be approached separately, deferring for a time incorporation into a larger system.

Before turning to these, we shall mention one other novel kind of communication in hospitals -- namely, using television for remote consultation (discussed in Section 7.5.8). This has been tried experimentally at Massachusetts General Hospital, and, while no formal evaluations have been completed, the program has been considered successful enough for continuation and expansion. The major benefit lies in convenience for the

patient, who does not have to make the trip to the hospital for consultation with a specialist. The problems which exist are procedural rather than technological. Since referral from a dispensary to a hospital clinic typically involves at least half a day of a patient's time and a TV link could reduce that time substantially, we recommend that remote TV consultation be tried between the prototype hospital and at least one of its satellite dispensaries.

2.5.8. MULTIPHASIC TESTING

In Section 5.4 we have reviewed multiphasic testing, typified by the Kaiser system, as an alternative to the conventional periodic physical examinations now given by the military services to their personnel. Multiphasic testing uses the computer to log all data collected and to produce a comprehensive, accurate, and legible report in which all abnormal findings are flagged. The multiphasic tests are a prelude to examination by a physician.

The following tests (phases) are included in the Kaiser examination:

- Registration and physician-appointment for followup study.
- Electrocardiography, with six leads recorded simultaneously on paper (including cardiologist's interpretation).
- Blood pressure and pulse rate measured in the supine position with automated instruments.
- Weight, subscapular and triceps skinfold thickness, height, and a dozen body measurements recorded by an automated anthropometer and punched directly into cards.
- Chest roentgenography, a 70-mm posteroanterior view (including radiologist's interpretation).
- Mammography (cephalocaudad and lateral views of each breast) in women over the age of 47, with radiologist's interpretation).

- Visual acuity tested by reading a wall chart, and a pupillary light reflex test.

- Ocular tension, measured by a Schiotz tonometer.

- Retinal photography of one eye (with ophthalmologist's interpretation).

- Achilles-reflex one-half relaxation time and an experimental pain reaction test (measured as pain tolerance to increasing pressure on the Achilles' tendon).

- Respirometry with forced expiratory vital capacity (one second, two second, and total) and peak flow.

- Audiometry tested with an automated audiometer for six tones.

- Tetanus-toxoid immunization with a high-pressure jet injector.

- A self-administered medical questionnaire for present and past history, a set of 200 medical questions, and an additional set of 155 psychologic questions on prepunched sort cards for automatic computer processing.

- Clinical laboratory tests, including hemoglobin, white-cell count, Venereal Disease Research Laboratories test for syphilis (VDRL), rheumatoid factor (latex-fixation slide test), blood grouping, eight blood chemical determinations (serum glucose, creatinine, albumin, total protein, cholesterol, uric acid, calcium, and transaminase), urinalysis for pH, blood, glucose, and protein (paper strip tests), and a urine culture for six hours with triphenyltetrazolium chloride.

This list is somewhat longer, particularly in the number of laboratory determinations, than that of the Standard Form 88 (Physical Examination) used by the military services. If automated testing cost no more than the present way of administering physical examinations, it would be preferable.

TABLE 2.5.2
SUMMARY OF ANNUAL COSTS FOR PHYSICAL EXAMINATIONS

	Kaiser	PES
Personnel	$148,000	$136,000
Supplies	62,000	30,000
Services	47,000	36,000
Equipment amortization	27,000	6,300
Computer	108,000	-
	$392,000	$208,300
Cost per exam (24,000 exams annually)	$16.30	$8.69

However, because the costs are so disparate (see Table 2.5.2), we do not believe that computer-based multiphasic testing has a role in base-level military hospitals.

This conclusion is strongly influenced by the fact that the military population is generally young and healthy, having been selected for those attributes. Were this not the case, the value of more thorough physical examinations might justify the cost. In the future, as physiological processes become better understood and more tests become part of standard examinations, this conclusion may be altered.

2.5.9. AUTOMATED PATIENT MONITORING

A half dozen or so large-scale, computer-based systems are now in experimental use for monitoring physiological variables of patients in intensive care units (ICU's). These are described more fully in Section 5.6. The computers not only monitor the range of the observed

variables and sound alarms when they go out of limits, but also compute derived variables which are believed to be valuable in making diagnostic judgments. Such systems offer the benefits of more measurements, continuous monitoring, convenient and clear display, higher accuracy, and machine-retrievable recording. They are expensive: the cheapest of this class costs $350,000 for hardware alone, and software costs a comparable amount. We do not believe such systems can be justified for base-level military hospitals.

Besides the large-scale systems, numerous smaller EKG monitors are available commercially and are already used in most civilian and military hospitals. For the time being, such stand-alone monitors are entirely adequate for military hospitals.

2.5.10. UNIT PACKAGE MEDICATIONS

Pharmacy operations account for between four and six percent of the operational costs of military hospitals. Since most of this expense represents the cost of drugs, a matter outside the scope of this study, large reductions in pharmacy costs cannot be expected.

On the other hand, the consequences of errors in drug administration can be serious, and, as discussed in Section 7.3, studies have shown that errors are not uncommon. Therefore, there is merit in attacking this problem. We have also noted that the filling of outpatient prescriptions accounts for between 70% and 90% of the volume of military pharmacies, and any innovations should seek improvements in this area as well.

Unit packaging is promising, both for reducing errors and for facilitating filling outpatient prescriptions. In this technique, common drugs (about 200 of which account for 80% of the orders written) are individually packaged on a paper strip.

The advantages claimed for unit packaging are the following:

- Identification of each medicine up to the time it is consumed by the patient,

- Reduction in preparation time and, in the case of liquid, reduction in time of administration,

- Prevention of possible contamination of medication,
- Reduction in medication errors,
- Provision for more accurate inventory control in the pharmacy and at the nursing station,
- Elimination of waste when unused medications are returned to the pharmacy,
- Better accountability for accurate medication charges,
- Reduction in drug inventories, deterioration, obsolescence, pilferage, and capital investment,
- Easier adaptation to automated dispensing machines.

However, the following disadvantages have been observed where unit packaging has been tried:

- Storage space requirements are greater than with traditional packages,
- Cost per unit is greater,
- No standards have been established with respect to size and printed matter on unit packaging,
- Unit packaging is less satisfactory for outpatients, because no automatic dispensing equipment is now avalaible,
- The range of dosage and form requirements is hard to accommodate in unit packaging,

- Not enough products are available in unit packages.

On balance, we have concluded that the advantages outweigh the disadvantages, though costs would probably increase somewhat, at least at first. (This conclusion is detailed in Section 7.3.)

To dispense outpatient prescriptions, we have envisioned a computer-driven machine in which some 200 commonly prescribed drugs are kept. The computer accepts card-encoded transcription of the original prescription, and records are kept on cards. We expect that such dispensers would cost about $150,000 to develop and might sell for about $30,000.

There are many other pharmacy functions which might be computerized. These include:

(1) Drug inventory
- Control information - storage figure
- Usage rates
- Replenishment of stock and purchasing information
- Vendor or source information for each drug (manufacturers, wholesalers, etc.)
- Expiration dates for stored medications
- Storage requirements (refrigerated, frozen items, etc.)

(2) Retrieval of drug data
- Doses and forms
- Usage (symptoms of diagnosis: as for diuretics, antibiotics, etc.)
- Interactions with other drugs or with foods
- Antidotes
- Duplications of generic medications
- Effect of drugs on laboratory tests
- Routes of administration

(3) Printing (in any language or symbol)
- Hospital formulary

- Prescription and prepack labels
- Auxiliary and cautionary labeling

(4) Charging, accounting or statistical information
- Medication scheduling
- Personnel scheduling by workload
- Work apportionment
- Budgetary information

(5) Formulas for pharmaceutical preparations
- Ingredients with quantities
- Costs of manufacturing

(6) Reagents with diagnostic tests (also, drugs affecting results)

(7) Patient medication histories

(8) Index of manufacturers' identification numbers (Parcode, Identicode, etc.)

Of these functions, the first two (inventory data and drug data) seem the most useful. We recommend development of a computer system to accomplish these functions. It is generally our philosophy that new developments of this kind should be attempted on a "stand-alone" basis; that is, the pharmacy computer at first should not be directly interactive with the communications computer, although the latter would, of course, have a terminal in the pharmacy.

2.5.11. AUTOMATION IN THE CLINICAL LABORATORY

The clinical laboratory, especially the chemistry laboratory, has received much attention from developers seeking to automate test procedures. Technicon is perhaps the best known of these companies, but it has numerous competitors, and new developments are appearing frequently.

In Section 7.6 we have reviewed the opportunities for greater automation of laboratory procedures. Military hospitals are already taking advantage of many of the commercial offerings, though in particular instances they could make greater use of automation than they now do.

The advantages of automated equipment are that it may be more precise, it may be more reliable and less liable to large error, it is usually faster, and it often reduces the number of technicians required, at least when there is adequate volume.

The variety of equipment is so great and the workload is so variable from hospital to hospital that it is impossible to specify particular items for all military hospitals. Instead, we have provided operating and cost data for making a choice and have illustrated their use with several examples, using the following criteria for selection:

- Required turn-around time
- Number of tests
- Diversity of tests

These considerations have led us to find some opportunities for greater automation at Walson Army Hospital and Jacksonville Naval Hospital, where the costs of the new equipment approximately equal the savings to be realized from it.

In investigating "fast analyzers", we have come to the conclusion that they hold far more promise in speeding up chemistry determinations than has so far been realized. We have described in Section 7.6 a fast analyzer system comprising several terminals (in dispensaries, clinics, and wards) and a central computer; this system would eliminate the need to transport patients or specimens to the laboratory and would provide virtually instantaneous determinations. It would require development, but it appears well worthwhile.

Computer systems in the clinical laboratory for logging in requests, making work plans, accepting results from automated equipment, making necessary computations, and printing or transmitting results are available from at least five commercial suppliers. While we doubt that such systems

can be justified on the basis of reduction in personnel, they do offer undeniable benefits in the quality of results, arising from the ease with which additional standards can be run, the strict adherence to routine demanded by computer systems, and the absence of human degradation due to fatigue. We believe that computers in this application should stand alone until communications computers are better developed.

2.5.12. OTHER COMPUTER APPLICATIONS

In Sections 7.5 and 7.7 we have reviewed several other computer applications for military hospitals:

- Report composition
- History-taking
- Computer-aided diagnosis
- Electrocardiographic analysis
- Appointment scheduling
- Nurse duty scheduling

For the most part, these applications are too new for us to be definitive about their merit. However, all have been developed and put into pilot operation, at least in restricted areas. The first three present a challenging opportunity for development on the part of the military medical community. While we cannot recommend them as proven tools in medical practice, their promise is great, and the Department of Defense may wish to contribute to their development, particularly in specialties like neuropsychiatry, which are especially important to military medicine.

Electrocardiographic analyzers exist in configurations ranging from large-scale computer systems (mentioned in Sections 2.5.9 and 5.6) down to small, hard-wired devices costing only a few thousand dollars. The evolution of these systems is certain to continue. We see little justification for DOD's direct participation in their development, since they are proceeding actively with other sources of support and DOD's needs in this regard are no different from those of other hospitals.

The last two items, appointment scheduling and nurse (or other

staff) duty scheduling, are reasonably straightforward computer applications. They would be natural add-ons to a computer-based communication system, and we recommend that they be pursued in this fashion, as a part of the experimental program in the prototype hospital.

2.5.13. CONVENIENCE FOOD SERVICE

Food service represents one of the largest single categories of expense in both capital outlays and operation, as can be seen from the tables in Section 1.6. As explained in Section 7.2, convenience foods offer an alternative to conventional food service which is cheaper both in capital investment and in operation. Although there is some basis for doubt, existing convenience food services have proved that quality, variety, and adherence to hospital standards need not suffer in well-run systems.

With a convenience food service, the preparation and portioning of food is done in the supplier's plant. Freezable food (which includes most entrees and cooked vegetables) are delivered frozen and stored. A day ahead of time they are allowed to thaw; the meals are then delivered to the wards or cafeterias, where they are heated in microwave ovens at serving time. Nonfreezable items such as salads, fruit, and milk are delivered daily in single-serving packages for assembly on meal trays. Coffee, tea, toast, and soup are prepared in individual amounts when meals are served. There is no kitchen in the hospital except for a vestigial kitchen for occasional special items.

Having reviewed carefully the merits and potential disadvantages of convenience foods, we have concluded that they are distinctly preferable to conventional foods in most military hospitals. An analysis of costs, summarized in Table 2.5.3, shows that convenience foods are markedly cheaper.

TABLE 2.5.3
COMPARISON OF COSTS BETWEEN
CONVENTIONAL AND CONVENIENCE FOOD
SERVICE SYSTEMS

	Fort Dix	Jacksonville	March
Operating Cost per Ration			
Conventional	$4.72	$4.90	$4.39
Convenience	3.73	4.17	3.85
Difference	$0.99	$0.73	$0.54
Capital Cost			
Conventional	$1,551,000	$811,000	$453,000
Convenience	1,195,000	626,000	340,000
Difference	$ 366,000	$185,000	$113,000

2.6. TOTAL IMPACT OF REORGANIZATION ON COSTS

In Table 2.6.1 we have assembled the savings attributable to our major recommendations for changes in base-level military health care:

- Introduction of light care facilities
- Reorganization of ambulatory care to make more use of nonphysicians
- More extensive use of dental assistants
- Vacuum trash and linen collection
- Introduction of wardclerks and wardmasters
- Introduction of unit package medication
- More automation in clinical laboratories
- Use of convenience foods

Detailed derivation of the costs assembled in this table are given in the appendices. Omitted from this list are a number of minor observations recorded in the appendices, improvements to facilities and the planning process, and most of the computer applications to clinical practice. The impact of improvements to facilities and planning is applied to the annual DOD construction budget rather than to individual military hospitals in Section 3.6, and the impact of a hypothetical redesign of the hospital at March AFB is detailed in Section 6.7.

In the case of computer applications, we have simply lacked convincing data for estimating their impact. Therefore, we have omitted most cost considerations from the pertinent discussion in Sections 2.5, 7.5, and 7.7. Rough estimates of leasing costs for existing systems are given in Section 7.5, but there is little basis for estimating potential savings. We expect that some of the potential savings in manpower are realizable, but their determination must await an evaluative experimental program in the prototype hospital.

TABLE 2.6.1
MAJOR IMPACT ON COSTS
(thousands of dollars)

	Fort Dix		Jacksonville		March	
	Capital	Operating	Capital	Operating	Capital	Operating
Existing System	$17,054[a]	$14,922[b]	$11,840[c]	$6,753[b]	$6,740[d]	$5,935[b]
Savings with Reorganized System						
Light care[e]	$ 1,935	$ 602	$ 1,441	$ 198	$ 277	$ 247
Ambulatory care[f]	---	195	---	114	---	114
Dental assistants[g]	(302)*	280	(129)	118	(56)	69
Vacuum trash and linen collection[h]	(357)	26	(183)	14	(189)	14
Nursing services[i]	---	60	---	30	---	18
Unit package medication[j]	(173)	(15)	(168)	(5)	(166)	(10)
Laboratory automation[k]	(84)	24	(69)	13	---	---
Convenience foods[l]	366	384	185	98	53	113
Totals	$ 1,385	$ 1,556	$ 1,097	$ 580	$ (81)	
Percent change	-8	-10	-9	- 9	+ 1	- 10

*Figures in parentheses represent additional costs rather than savings

a. Original construction in 1960 at Walson Army Hospital cost $8,604,000 and equipment $2,154,000; capital additions since, the bulk of which occurred in 1965, have cost $1,797,000 (see Sections 3.2.3 and 8.1.2.1). By applying a building cost inflation factor of 1.46 between 1960 and 1970 and of 1.28 between 1965 and 1970 from Engineering News Record (Table 6.7.2), we arrive at the capital cost shown, which should be regarded as replacement costs; equipment costs were not inflated.

b. Total annual operating expenses for FY 69 (from Section 1.6).

c. Original construction in 1967 at Jacksonville cost $8,922,000 and equipment $940,000. By applying an inflation factor of 1.22 between 1967 and 1970, we arrive at the capital cost shown; equipment costs were not inflated.

d. Original construction in 1965 at March AFB cost $4,715,000 and equipment is estimated at $700,000. By applying an inflation factor of 1.28 between 1965 and 1970, we arrive at the capital cost shown; equipment costs were not inflated.

e. Savings in capital cost of $1,441,000 at Jacksonville were estimated with some care by staff of Lester Gorsline Associates. Savings in capital costs at Fort Dix and March AFB were estimated by scaling savings in proportion to the number of beds involved in the light care facility (see Section 2.3.5); savings in operating costs reflect items shown in Figure 2.3.6 (nursing personnel, linen and laundry, and housekeeping).

f. No change in capital costs for reorganization of ambulatory care has been noted, since facilities are incidental to the

concept. Operating savings were derived in Table 2.4.17, which used $6000 as the annual saving when a nonphysician is substituted for a physician.

g. Costs taken from Table 5.2.11. They include the increment to capital costs for circular operatories and the reduction in salaries owing to displacement of dental officers by dental assistants offset by the cost of additional training.

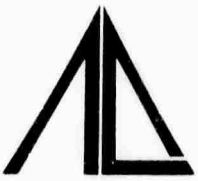
h. Costs developed from data in Tables 7.1.6 and 7.1.12; capital expenses include purchase and installation of collection system. No change was made in number of carts, since they are still needed for local pick-up. Operating expenses reflect staff savings less maintenance and power costs for vacuum system.

i. Changes in operating costs reflect salary differences between nurses and wardclerks or wardmasters, as discussed in Section 5.3.3.

j. Additions to capital and operating expenses are taken from Table 7.3.3; they reflect additional costs for unit packaging (15% of the cost of drugs) and additional technicians in the pharmacy, diminished by savings in nursing staff. The increase in capital cost is accounted for mainly by computer costs.

k. Additional capital costs and operating savings taken from Section 7.6.5; they reflect introduction of more automated equipment in the chemistry laboratory.

l. Savings in capital costs are taken from Table 2.5.3. Savings in operating costs are taken from the same table, with the cost per ration multiplied by 388,000 rations per year at Fort Dix, 134,600 at Jacksonville, and 98,900 at March AFB.



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